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Saving – but where?

That the global economic situation is presently not at its peak is all too manifest. Talking ourselves into a depression doesn't help us any, but neither does smooth-talking. To act and to react, that's what counts. But where to start reacting? The answer most frequently heard is, to save. And this is where the dilemma starts. The most simplistic management attitude (which, in effect, isn't one) is to reduce personnel, vulgarly called "firing". A fantastic short-term success, as the saving in wage and non-wage labor costs become quickly visible. There's a shortage of work anyhow, so let's get rid of people. Tough luck, if work returns – who is there to do it? And that work, i.e. orders, will return is every employer's hope – otherwise he might as well quit and go home. So, firing will earn him no bonus. It would have been better for the enterprise if he had fired himself.

Next possibility: Freeze investments. May make sense, but can easily backfire. Lately, I have heard in talks with members of the metrology and quality control business community that orders were cancelled or postponed, or acceptance of items already manufactured was refused. Such occurrences happen mostly in the automotive industry and its suppliers. What does that mean in plain language? Measuring instruments and testing apparatus like coordinate measuring machines, surface and material testing machines, optical measuring systems, etc. will largely be used in quality assurance. Shelving necessary investments for quality assurance applications (rarely is there a superfluous investment) means that cars and their sub-supplied parts are no longer checked with optimum equipment. Again, in plain language: the quality level drops. Okay, no big deal at present, as all compact cars produced to date are sold anyhow thanks to the scrapping-bonus plan, and so there is no demand to speak of in the next few years. Big cars will be in the storage yard a bit longer, waiting for better times. Now, wouldn't it be better to be able to offer new products with optimum quality when the economy takes off again?

One more saving potential: marketing, trade fairs and conventions. Already, participants are staying away from international conventions. Travels are costly and they are first in line for cutting within companies. Word hasn't got around that this means renouncing professional education, exchange and new impulses. Let's have a look at trade fairs. Quite a few big, or medium and small size companies are forgoing their (probably important) appearance at fairs this year. One could justly ask whether is wise not to show the flag when orders are scarce. Should one not grasp every opportunity to draw attention to oneself and one's performance, in order to get a piece or two of the small remaining cake? The same is true for presence in the media.

All this is reacting. Then what about positive action? Every crisis holds its chance. Let's use the production capacity now released to make people develop new ideas and improvements. Let's use the time to examine and optimize procedures, scrutinize jealously guarded in-house domains and trodden paths (by practicing Kaizen, for example). Things that had no place in a hectic, overworked routine of past days. And indeed, occupying oneself with these things, one discovers saving possibilities in corners where money was burned undetected.

Harald Grobholz

NEWS

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COVER STORY

VISION

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31. 3. — 2. 4. 2009
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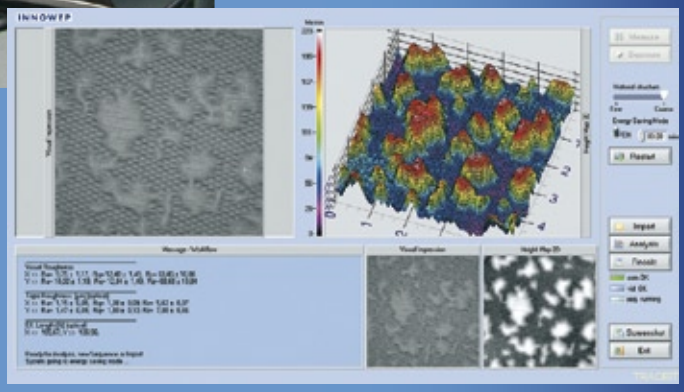

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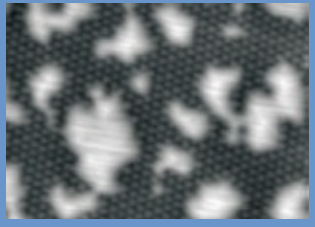

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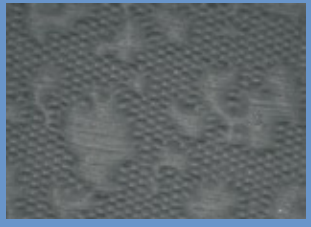

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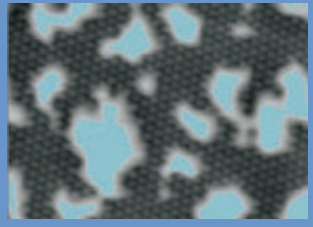

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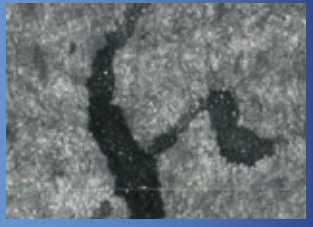

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Machine Vision in the UK

Don Braggins Presents the UK Vision Scene

The UK Industrial Vision Association (UKIVA) was established in 1992 as a not-for profit trade organization whose prime objective was to promote the use of imaging in industry. Over the years it has expanded its remit a number of times to reflect the dynamics of the imaging world and changes in use of vision in the UK and now includes applications of imaging in science. Members include vision component suppliers, ‚full system' suppliers, or system integrators, consultancy services and academic research groups.

Advances in processing, camera and lighting technology have revolutionized the vision industry and newer techniques such as infrared, X-ray, high-speed and 3D imaging are all important parts of vision in the UK. Back in 1992 most vision components were manufactured in North America but now there are many European manufacturers. All of the leading manufacturers of vision components are represented in the UK, either through wholly owned subsidiaries or through well-established specialist distributors. Although availability of vision components is well catered for in the UK, there are other areas of the industry that could be improved.

Demand for System Integrators

UKIVA members say that adoption of machine vision in the UK could be accelerated further if there were more suitably experienced system integrators who can provide a 'turnkey' solution for manufacturers. Academia plays an important role both in research activities that can lead to new product development and in developing new generations of 'vision literate' graduates to capitalize on the benefits offered by vision. Unfortunately the UK university system is focused on building skills to develop machine vision algorithms, whereas industry needs engineers who understand how to apply machine vision tools to build systems. However, other sources of funding, notably from the UK government's former Department of Trade and Industry (DTI) (now BERR) technology programs and the European Union allow many universities (including UKIVA research members) to carry out a mixture of pure and applied research as well as being involved in consultancy projects with machine vision partners, even leading to the formation of industry-specific spin-off companies.

The UKIVA

One of the key achievements of the UKIVA has been in establishing itself as a renowned knowledge centre for matters related to industrial imaging. The UKIVA web site (www.ukiva.org) has been designed to be a machine vision information hub. It is the first port of call for many who are seeking to introduce a vision system.
The Association also offers free advice via phone (+44 1763 261419) or e-mail (info@ukiva.org) to anyone seeking help in specifying or sourcing vision systems or components.

Knowledge Transfer Networks

Another important change in recent years has been the formation by the DTI of a number of Knowledge Transfer Networks (www.berr.gov.uk/dius/innovation/technologystrategyboard/tsb/technology-programme/KTN/page12567.html), aimed at getting the knowledge that our univer-

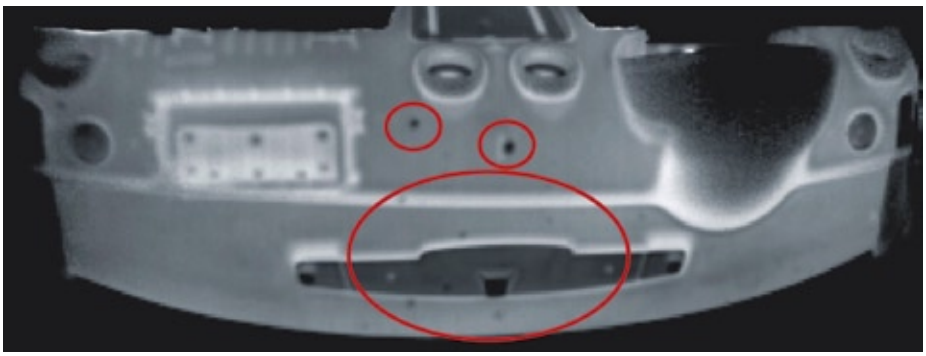
sities and research centers have into industry. Although there is no specific 'Imaging' KTN, imaging falls into the broader remit of the Photonics KTN. It seems that in the UK, the vision industry itself may have to become the driving force to maintain and further develop the interface with universities.

The UK vision industry survived the 1992 recession better than, for instance, its French counterparts, but there are already a few signs (such as reducing or not taking exhibition space) that the industry is adopting a cautious approach. The UK vision industry includes relatively few manufacturing suppliers to industries such as semiconductors, electronics, and steel which have historically suffered the steepest downturns during recessions, and informal discussions amongst UKIVA members suggest that where vision can reduce labour costs a recession may actually be a good time to persuade users to invest in vision (provided, of course, that they can obtain investment funding).

Application Trends

Inspection remains the biggest single application for vision in the UK, ranging from checking for defects on a production line, to being linked directly into the production process to provide statistical data from the measurements being made. Statistical process control methods are used to improve product quality, reduce wastage, improve productivity and streamline the process. In so doing, profitability will be maximized.

Other important application areas are product traceability and robot vision.



IR image showing cavities in foam dashboards **(Courtesy FLIR Systems)**

Tracking a component and all the processes it has gone through, from manufacturing, assembly right through to end-user requirements for spare parts replacement (from the cradle to the grave) is becoming an essential requirement as ERP, MRP and quality assurance systems become more widespread throughout the manufacturing supply chain.

The 2D Datamatrix code is an increasingly popular method of product marking. Industrial vision systems are used to verify these 2D codes with the highest degree of accuracy and reliability and often at high line speeds.

Robot vision applications fall typically into two application areas: robot vision, where the robot presents the product or component to the vision system for inspection, or robot guidance, where vision systems give the robot the ability to "see". This allows visual inspection of the robot working area as well as guidance based on the detected position of a product or component. Of course it is also possible to combine the two so that vision is used to pick the product for further inspection. By linking robotics and vision into automatic procedures, additional flexibility is introduced into production lines to enable different types of products to be handled on the same line.

In the UK, vision is used extensively in a variety of industries, including automotive, food and beverage, packaging and pharmaceutical.

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Centre for Electronic Imaging

The Open University and e2v have announced a collaboration to open the e2v Centre for Electronic Imaging (CEI) at The Open University's Milton Keynes campus. The centre will be dedicated to the research and development of advanced technologies for electronic image sensing and provide knowledge exchange between the UK technology industry and the academic world. The collaboration will see The Open University and e2v investing £ 3million in the UK knowledge economy over five years in new research activity through the e2v CEI. e2v is a world leader in the design and supply of image sensors to organisations such as NASA, whilst The Open University's Planetary and Space Science Department (PSSRI) is a world leader in the development of instrumentation for Space Science. The joint research centre (CEI) will focus on the development of technology opportunities in space and terrestrial imaging, with plans to extend to the scope to health and environmental applications.
www.open.ac.uk
www.e2v.com

Hexagon Acquires French 3D Software Company

Hexagon announced the acquisition of Technodigit, developer of 3DReshaper software, a software package that takes three dimensional data from scanning devices and allows point cloud processing, surface reconstruction and geometric shape extraction. The 3DReshaper Application is a fully-realized 3D package on its own, with powerful features like the ability to import point clouds of unlimited size, mesh shaping and editing and 3D surface comparison for inspection. Users appreciate the wide variety of capabilities that 3DReshaper brings to the table. The acquisition is effective immediately, and the Technodigit development team will join the Hexagon Metrology software development group, which employs more than 100 in-house developers worldwide.
www.technodigit.com
www.hexagonmetrology.com

New Distributor in Taiwan

Point Grey Research announced the appointment of Apo Star as its sole distributor in Taiwan. Headquartered in Taipei City, Apo Star will market, sell and support all Point Grey products in Taiwan, including Point Grey's line of IEEE-1394 (FireWire) and USB 2.0 cameras. Customers will see immediate benefits as a result of providing local distribution of Point Grey products through Apo Star such as faster response times and local technical support. With immediate effect, Apo Star, managed by Ng Ser Guan, will be the first point of contact and handle all product inquiries, orders and technical support for Point Grey's customers in Taiwan.
www.ptgrey.com

North American Robot Orders Fall

North American based robotics companies report that new orders sold to North American manufacturing companies fell by 21% in units and 16% in dollars in 2008 compared to 2007. The sharp decline accelerated in the fourth quarter when orders fell by 26% in units and 33% in dollars compared with last year. A total of 12,557 robots valued at US$ 894.9 million were ordered by North American companies in 2008, down from 15,856 robots valued at US$ 1.07 billion last year. When sales to companies outside North America are included, the totals are 14,109 robots valued at US$ 979.4 million, a drop of 18% in units and 15% in dollars. Despite the current difficulties in the automotive industry, there is reason for optimism, said Tammy Mulcahy of ABB Robotics, Chair of RIA's Statistics Committee. "In times of rising energy costs and rising environmental awareness, the demand for smaller, more economical, environmentally friendly and lower cost cars, are becoming increasingly important," Mulcahy noted.
www.robotics.org

NELA Acquires OMCS Optical Measurement

In an asset deal, NELA Brüder Neumeister, Lahr/Germany, acquires the entire product range of OMCS Optical Measurement, Dessau/Germany. NELA is the largest supplier worldwide of optical register systems for offset printing plates and corresponding plate automation systems. OMCS is a leader in the field of optical surface inspection systems for the industrial examination of rubber, polymer and ceramic parts. "This acquisition is a strategic move and it combines the latest and most powerful technologies in an ideal way with our expertise in the field of optical inspection systems," states President Frank Neumeister. The automated and touch-less inspection of mass parts and composite materials offers many business opportunities as industry requirements for precise, gapless and fully automated inspection of entire batches are quite considerable.
www.nela.de

Michael Cyros Re-Elected as AIA President

The Automated Imaging Association (AIA) announced its newly elected Board of Directors for 2009–2010 at its annual Business Conference in San Diego, California. The AIA is the world's largest trade association for the global machine vision and imaging industry. Michael Cyros, President of Allied Vision Technologies, has been re-elected President for 2009. "I am pleased to continue serving the industry in this important role," Cyros said. "With today's economic situation, companies need their trade association more than ever. We will continue helping our members expand their business through our initiatives in new market development, education, and our commitment to global standards development. We'll further support the industry with events like The Vision Show and the International Robots, Vision & Motion Control Show.
www.machinevisiononline.org

Silicon Software with Strong Distribution Partner

Silicon Software announced Militram as a new distribution partner and sales channel for its Machine Vision product line in Israel. The company was founded in May 1974 in Tel Aviv and is one of the main representatives of foreign high-tech companies in Israel. The company has an outstanding team of professionals who provide expert advice to customers on equipment and the sub assemblies they need. Militrams main involvement is with high technology products that require "engineering-in" and that are state of the art. Silicon Software is a manufacturer of intelligent preprocessing solutions based on reprogrammable FPGA technology for machine vision applications. The hard- and software products are designed for flexibility, easy handling and performance featuring user programmable FPGA technology.
www.silicon-software.com

Major Camera Suppliers for Strategic Alliance

Cognex announced the launch of the Cognex Acquisition Alliance. Through the Acquisition Alliance, Cognex establishes strong technical and marketing relationships with major camera manufacturers. This strategic partnership program provides mutual customers with best-in-class, integrated machine vision solutions. Benefits of the program include rapid integration and qualification of new partner cameras with Cognex VisionPro software through vendor self-verification and enhanced customer service due to product cross-training. The following suppliers have already joined the Acquisition Alliance: Allied Vision Technologies, Basler, Dalsa, e2V, Imperx, JAI, Point Grey Research and Prosilica.
www.cognex.com

Stemmer Imaging is Mikrotron Salespartner

As part of the expansion of its international sales network, Mikrotron could win Stemmer Imaging as a new distributor for the sales territories of Germany, Austria and Switzerland. For this Mikrotron extends the good cooperation with the Stemmer Imaging Group. In the distribution areas England and France the English and French subsidiaries of Stemmer Imaging have been in charge of selling Cameras of the company since the last two years. The new distribution agreement includes both; the current models of Machine Vision Cameras MC-1360/61 and MC-1362/63 series, as well as the older models of the camera-generation MC 1302/03, MC 1310/11 and MC 1324/25. The High Speed Cameras MC 1360/61 EoSens and MC 1362/63 EoSens have a maximum resolution of 1,280 x 1,024 pixels with a recording frequency of 120 respectively 500 frames per second. These are the frame rates of 8 or 10 bits transferred via Camera Link or Gigabit Ethernet.
www.mikrotron.de

Isra Vision: Management Expansion

Isra Vision is bolstering its growth by increasing its infrastructure. To this end, the dynamic, globally operating company is enhancing its financial management. The company has appointed Martin Heinrich to the position of Chief Financial Officer (CFO). Isra already benefits from a great deal of planning reliability, as its figures for the 2007/2008 fiscal year show. The augmentation to the financial management will ensure this standard even with continued dynamic growth, further improving the efficiency of the risk management. Until now, these tasks have fallen to the chairman of the board, who will nevertheless continue to personally oversee the Investor Relations division.
www.isravision.com

LMI Announces Distribution Agreement

The Vision 2008 trade fair in Stuttgart, Germany at the beginning of November presented a wonderful opportunity for LMI Technologies (LMI) to launch its maestro product line to the worldwide machine vision industry. As industry members know, Germany is the hub for innovative engineering design, so it's no surprise that most of the key customers, manufacturers, and distributors in this market were available to review new products and discuss opportunities. As one example of the interest that the maestro launch had, LMI is pleased to announce that DVC Machinevision bv (DVC) signed an exclusive distribution agreement during the show. In the future DVC will be the exclusive distributor in Belgium, The Netherlands, and Luxembourg for the products brands: FireSync, HexSight, and maestro. DVC is located in Breda, The Netherlands.
www.lmitechnologies.com

dhs Solution Expands Distribution Network

Software maker dhs is one of the pioneers and leading providers of Digital Imaging. One of its latest product lines is the dhs-Cleanalyzer, an all-in-one tool for "cleanliness analysis", in which components are cleaned and the cleaning solution passed through a filter. The dirt particles trapped in the filter are identified and analyzed by the tool. Demand for this solution has been very strong in recent years, particularly in the automotive industry.
www.dhssolution.com

Quelle: istock, Kurt Hansson

GigabitEthernet

or the Return of Frame Grabbers

The transition from analog to digital camera technology was already forecasted long years ago. But only the availability of cameras based on affordable digital standard interfaces caused a perceptible change. USB2, Firewire and GigabitEthernet as PC standard interfaces competed with different strengths and weaknesses and found their specific markets hereby.

With the use of that kind of interfaces, the frame grabber functionality was shifted into the camera and thus remains invisible as a stand alone component. But hereby cameras require drivers and API/SDK as interface to applications.

Digital standard cameras developed from a former analog application focus to demanding applications by the integration of faster sensors. Today's cameras achieve the practical performance limits of their interfaces. Meanwhile successive specifications for higher bandwidths are released for all interface technologies.

Growth

GigabitEthernet meets an above average growth in the range of industrial cameras now. This industrial technology is not only the most established one but also the most predictable one for future perspectives. Adaptations to requirements in Machine Vision were made, but there are general technological barriers, which prevent GigabitEthernet from a universal usage, compared to other standards like CameraLink. The use of dedicated network interface cards (NIC) eases the integration in lots of applications, but can't offer necessary or even specialized functionality.

Growth Barriers

GigabitEthernet uses a packet-based transfer protocol, which is processed on the host CPU. Each transferred packet releases an interrupt. One packet consists of meta information and payload: the image data. For a better relation between the static meta information and the payload, the packet size can be enhanced to a so called "jumbo packet size". It lowers the protocol overhead percentage, but increases the latency and the probability of a transmission error. Summarizing, GigabitEthernet can be used as non-deterministic transfer technology with known problems of low protocol efficiency, a probable loss of data packets, a significant load of the host CPU, latencies by driver implementation, and jitters by packet sizes.

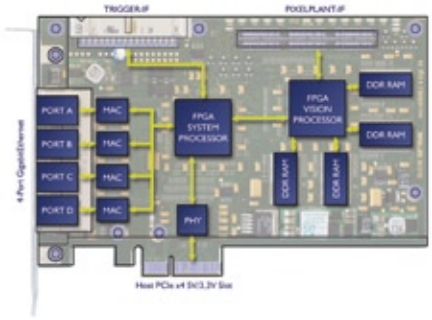
Besides the load of the host CPU by the interrupt handling of the data transmission, the incoming data packets have to be rebuilt to an image and converted into a suitable image format for the subsequent image processing. In most cases, it is necessary to pre-process the images by certain image enhancements, sensor or shading corrections, and color reconstruction or color space conversion. Only hereafter the images can be sent to the according image processing software for a content analysis.

Problems of that kind are even more evident in multi camera systems. The computer is mainly involved in the administration of data transmission but in the processing of transferred images. The CPU load for the pure image acquisition task can increase to more than 20 % in a four-camera system. However, with the use of a specialized GigabitEthernet frame grabber like the microEnable IV-GigE, the load can decrease again to 2–3 %. The frame grabber works as an interconnected buffer system, which rebuilds complete images from data packets. The host computer will process only one interrupt per image afterwards.

Advantage Multiplex

A further advantage is the possibility of a multiplexed image acquisition. Giga-

microEnable IV-GigE is GigE-Vision and Gen<i>Cam compatible and thereby supports all compatible cameras (here: Basler scout models)



Schematic block diagram of microEnable IV-GigE

bitEthernet allows a less expensive setup of a distributed camera infrastructure by use of switches. Many applications integrate numerous cameras, which are infrequently activated at the same time. Four physical camera ports are available for the image acquisition. The frame grabber assigns data packets from the according cameras, reconstructs the images and transfers them to the host PC. That is organized by virtual camera ports and DMA channels. In the final completion, microEnable IV-GigE will support up to eight cameras per port. Hereby the board will individually control up to 32 cameras. The limitation of the image acquisition bandwidth will remain at more than 100 Mbytes/sec. per port.

GigE Grabber

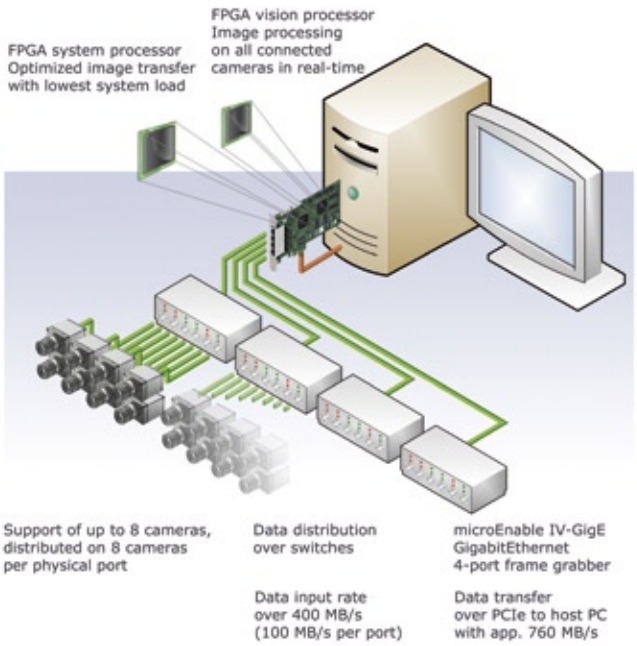
The GigabitEthernet frame grabber is identified in the PC system as an image processing component. Hereby the hardware is integrated in a new system with minimal effort and the image processing software can be used immediately. The system's network stack is not replaced and thus problems with existing drivers are prevented.

The user receives a SDK, which is focused on Machine Vision experts by the scope of functions. Moreover the SDK for CameraLink and GigabitEthernet camera systems is approximate. The programmer will continue working with the same mechanism and convenience. Existing applications have to be only marginally adapted to the new camera interface. Moreover a user can choose between the Silicon Software SDK and the Gen<i>Cam programming interface for GigabitEthernet applications.

Real-time Functionality on Top

With microEnable IV-GigE, Silicon Software offers a PCIe based image acquisition and processing solution. The board is equipped with four GigabitEthernet camera ports, 512 MBytes DDR-RAM onboard and two FPGAs as system processor and vision processor. An additional I/O interface allows the control of cameras, external peripherals and general signal sources like encoders and strobes. The board achieves a practical data transfer rate to the host PC of 760 Mbytes/sec by a quad lane PCIe interface (PCIe x4).

The input rate per port is limited to 1000 GBit/sec or more than 100 Mbytes/sec in practice by the GigabitEthernet technology. Hereby a total input bandwidth of 400 Mbytes/sec. can be achieved. microEnable IV-GigE is technologically based on the microEnable IV frame grabber series and profits from the advantage



Multiplexed image acquisition from cameras with microEnable IV-GigE

With microEnable IV-GigE, Silicon Software offers a PCIe based image acquisition and processing solution

of a comprehensive operation system support for Windows and Linux as well as for 32bit and 64bit systems. The GigabitEthernet frame grabber is GigE-Vision and Gen<i>Cam compatible and thereby supports all compatible cameras.

microEnable IV-GigE offers the basic functionality of an image acquisition frame grabber and additionally special operation modes and processing functions. The image processing functions can be implemented by the graphical FPGA programming software VisualApplets and are processed on the vision processor in real-time. The advantage to realize customized image pre-processing on each camera, which is connected to the frame grabber, is an additional benefit, which was formerly reserved exclusively to users of vision processor boards for CameraLink or LVDS.

GigabitEthernet is a modern technology, which requires an examination of its weaknesses, but also offers a high potential for new solution approaches.

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Source: Flickr, Hans and Carolyn

Child's Play

Image Processing Basics: Shape Detection

Human visual perception is excellent in detecting shapes of objects. Even small children will easily differentiate between circles, squares or triangles when wooden toys or sweets are at stake. Similarly, machine vision applications on the factory floor or in the open environment sometimes call for quantitative parameters to characterize a shape. Traffic signs, e.g., may well be pre-classified by their shape, and for some pills the integrity of their shape is an important issue in quality control. This article describes some simple, well-known methods of shape detection.

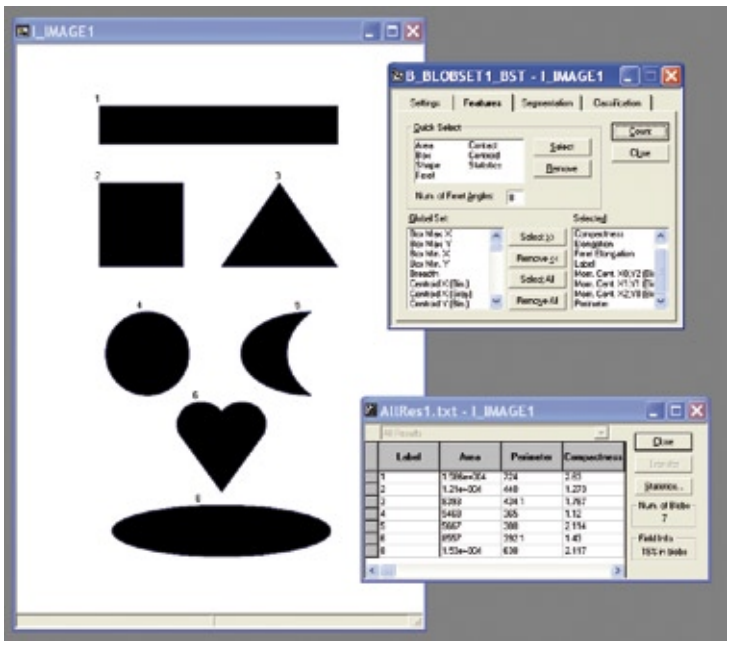

Fig. 1: Some simple shapes in a binary image and results of the blob-analysis

A method for shape-detection has to provide a quantitative parameter as a unique means for characterizing the shape of an object, independent of its orientation, position and dimensions. Let us look at the simple, two-dimensional case: the objects are on a flat surface and are flat themselves. Optical imaging is supposed to have no influence on the shape, that is perspective, optical distortions, inhomogeneous lighting, the spatial variation of the efficiency of the lens and compression or expansion due to image acquisition are negligible or have been corrected. To keep our approach simple, let us for the time being deal with objects without holes and with good contrast to the background only. An image which might result under these conditions is shown in figure 1. A human observer will immediately be able to describe the objects by naming their shapes: rectangle, square, circle, triangle, moon, heart, ellipse. A quantitative measure for these shapes is the compactness. The basic idea behind this feature is the fact that the circle is the geometrical figure with the smallest circumference for a given area. A square is less compact than a circle with the same area, since its circumference is larger. For a circle with radius r the ratio between circumference U and area A is $2\pi r/\pi r^2$, that is 2/r; for the square with edge length a the ratio is $4a/a^2$, that is 4/a. This parameter is invariant under rotation, but depends upon the linear dimensions. A better choice is the ratio U^2/A, where the linear dimensions r and a, respectively, are eliminated. For the

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Innovation in Imaging

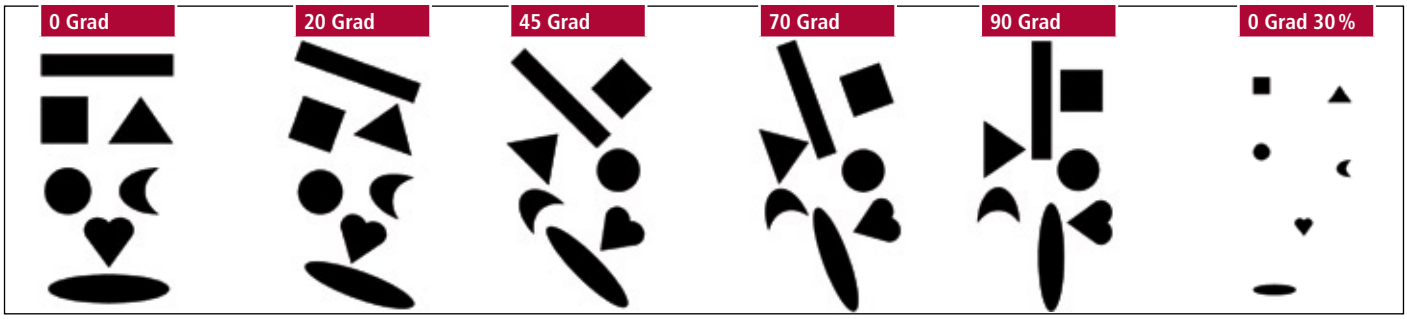

Fig. 2: The binary image from figure 1 with different orientations and scaled-down to 30%

circle, this feature has the value 4π, for the square the value 16, independent of the dimension of the object, the orientation or the position in the image.

Compactness

Most image processing libraries provide the compactness or a similar feature in their blob-analysis. Often, this shape-parameter is normalized to get the value 1 for the circle. Within the tool which was used for the blob-analysis in figure 1 the "compactness" is calculated as $U^2/4\pi A$. Other shapes will thus have a "compactness" larger than 1. Some other tools prefer the reciprocal value. Closer inspection of the result-listing in figure 1 shows that rectangle, square, triangle, circle and heart can well be differentiated by their compactness. The value for the circle, however, is significantly different from the theoretical value 1. There are two reasons for this strange effect. First, there exist different methods to calculate the circumference of an object. Some methods just take the number of pixels on the contour, some use the factor $\sqrt{2}$ to account for diagonal steps, others calculate the circumference from the chain-code as the total length of the lines connecting the centers of the contour pixels. Similar differences exist for the calculation of the area. An extreme example shows the problem: for an object which consists of a single pixel only, one method may yield the value 1 for the area and 4 for the circumference, another method may result in 0 for the area and 0 for the circumference. Second, every object in the digital plane is made up of pixels, it is discrete. Circles are always approximated as polygons. Therefore, features describing the area and the circumference of an object may show deviations from the ideal values. Both effects will have an influence when the compactness is calculated. The discrete nature of the digital plane will usually be more important for smaller than for larger blobs or relevant structures. An-

Table 1: Compactness and normalized moment of inertia for the objects in figure 2

0 Grad	U^2/A	Iz/A^2	$100Iz/A^2$
Rechteck	33,05	0,5217	52,17
Quadrat	16,00	0,1667	16,67
Dreieck	22,45	0,1956	19,56
Kreis	14,07	0,1592	15,92
Mond	26,57	0,2168	21,68
Herz	17,97	0,1747	17,47
Ellipse	26,60	0,3523	35,23
20 Grad			
Rechteck	38,40	0,5199	51,99
Quadrat	18,54	0,1665	16,65
Dreieck	23,69	0,1955	19,55
Kreis	14,18	0,1592	15,92
Mond	26,46	0,2168	21,68
Herz	18,16	0,1747	17,47
Ellipse	27,58	0,3536	35,36
45 Grad			
Rechteck	33,13	0,5229	52,29
Quadrat	15,96	0,1666	16,66
Dreieck	22,32	0,1956	19,56
Kreis	14,07	0,1592	15,92
Mond	26,46	0,2165	21,65
Herz	17,91	0,1746	17,46
Ellipse	26,75	0,3550	35,50
70 Grad			
Rechteck	38,46	0,5195	51,95
Quadrat	18,64	0,1667	16,67
Dreieck	23,90	0,1956	19,56
Kreis	14,06	0,1592	15,92
Mond	26,57	0,2163	21,63
Herz	18,18	0,1747	17,47
Ellipse	27,72	0,3538	35,38
90 Grad			
Rechteck	33,05	0,5217	52,17
Quadrat	16,00	0,1667	16,67
Dreieck	22,27	0,1955	19,55
Kreis	14,07	0,1592	15,92
Mond	26,55	0,2163	21,63
Herz	18,02	0,1748	17,48
Ellipse	26,71	0,3529	35,29
0 Grad 30 %			
Rechteck	32,18	0,5035	50,35
Quadrat	16,00	0,1666	16,66
Dreieck	21,93	0,1954	19,54
Kreis	14,41	0,1591	15,91
Mond	26,15	0,2178	21,78
Herz	18,32	0,1741	17,41
Ellipse	26,29	0,3433	34,33

other interesting observation in the result-listing of figure 1 is the striking similarity between the compactness of the moon-like object and the ellipse. For an application in industrial image processing or a machine-vision task the stability of the features is always an issue and has to be carefully checked to meet the requirements of the task. Since the circumference is sensitive for noise in the grey-level signal, we may well make the educated guess that the compactness will not provide a safe basis to distinguish between these two shapes in an application on the factory floor.

Stability

The sequence of images in figure 2 and the values for the features in the corresponding table 1 gives a first impression of the stability of the parameters. The shapes in figure 1 have been rotated by an angle of 20°, 45°, 70° and 90° with respect to their original orientation. A further image shows the same objects scaled down to 30% of their original size. In figure 3 two of the shapes, heart and ellipse, are shown in arbitrary orientations and dimensions. The corresponding features are listed in table 2. As a measure for compactness the term U^2/A has been calculated. The values for U and A have been taken from the blob-analysis provided by the tool used in figure 1. For some shapes the orientation seems to have a large effect on the value for the compactness. The compactness of the square, e.g., varies between 16.0 and 18.6, which amounts to a relative range of 15%. The same range appears for the rectangle. The results also confirm that the shapes "moon" and "ellipse" can not be properly distinguished by compactness. Values for the ellipses range between 26.60 and 27.72, for the moon-like object between 26.46 and 26.57. In addition, for the image where the objects have been scaled down to 30%, ellipse and moon have compactness-values of 26.29 and 26.15, respectively. Thus, when

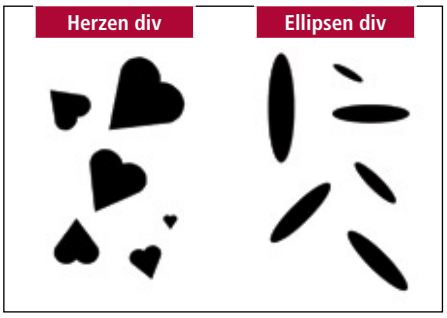

Fig. 3: Hearts and ellipses with arbitrary orientations and dimensions

Table 2: Compactness and normalized moment of inertia for the objects in figure 3

Herzen div	Fläche A	Umfang U	U^2/A	Iz/A^2	$100Iz/A^2$
1	24970	668,7	17,91	0,1748	17,48
2	7403	362,9	17,79	0,1745	17,45
3	15690	532,3	18,06	0,1747	17,47
4	801	118,7	17,59	0,1740	17,40
5	8549	392,9	18,06	0,1747	17,47
6	4405	281,8	18,03	0,1745	17,45
Ellipsen div					
1	15300	636,9	26,51	0,3512	35,12
2	1417	196,0	27,11	0,3456	34,56
3	7586	449,4	26,62	0,3510	35,10
4	4044	328,4	26,67	0,3540	35,40
5	8667	481,6	26,76	0,3541	35,41
6	8673	482,1	26,80	0,3536	35,36

orientation and dimension are changed independent of each other, the intervals for the compactness of ellipse and moon will overlap. Figure 3 and the corresponding table 2 show that the situation for hearts and ellipses is much better. The relative range for the compactness is about 2.5 % only and will add up to about 5 %, when the values from figure 2 are also taken into account, but without any reasonable risk of overlap.

Moment of Inertia

Ellipse and moon may well be distinguished from each other by means of another, well-known feature for shape detection: the moment of inertia. Moments are statistical parameters. In general, the moment m_{pq} of a cloud of pixels with coordinates (x, y) is calculated as $\Sigma x^p y^q$; p and q are integers. The moment m_{00}, e.g., is equal to the number of pixels in the foreground and usually is taken as a measure for the area. The moments m_{02} and m_{20} have the structure Σy^2 und Σx^2; they are similar to the moment of inertia with respect to the x-axis and the y-axis, respectively. For shape-detection, these moments are first calculated with respect to the centre of mass (x_s, y_s) of an object („centered"), thus having the form $\Sigma(x-x_s)^2$ and $\Sigma(y-y_s)^2$, respectively. These are the moments of inertia I_y and I_x, respectively, with respect to an axis parallel to the y- and x-axis, respectively, through the centre of mass of the object. A circle has the same moment of inertia for both directions. An elongated ellipse with the semi-major axis parallel to the x-axis like in figure 1 has a small moment of inertia with respect to the x-axis and a large moment of inertia with respect to the y-axis. The sum of both moments is invariant under rotation and corresponds to the moment of inertia I_z of the object with respect to an axis perpendicular to the image plane. Normalizing the moments, in this case to the square of the area, yields a feature independent of the dimensions of the object. Such parameters are called normalized, centered moments. The feature I_z/A^2 is listed in table 1 and 2. The data show that the moon-like shape and the ellipse can be distinguished by this parameter, even when variations of orientation and dimensions occur. For the other shapes this feature also is quite stable in comparison with the compactness. The absolute numerical differences between the values seem to be small for some shapes, but the stability of this feature against rotation and scaling is good enough to take it into account for shape-detection even in these cases. The combination of several different centered, normalized moments leads to the construction of further features suited for shape-detection [1]. By weighting with the grey-level of an object-pixel the concept of moments may even be applied to grey-level images. And another advantage of moments compared to the features generated by blob-analysis may be of importance: moments may be calculated for arbitrary groups of pixels, whether they are connected or not, whereas blob-analysis always needs binary objects made up of closely connected pixels.

Conclusion

Shape-features have to be invariant under rotation, translation and scaling. Shape detection is not a simple task, even with two-dimensional objects and optimum conditions for image acquisition. The discrete nature of the image plane may lead to significant deviations from the ideal values for simple shape indicators such as the compactness. These features, however, may be well suited when only a few, well-defined shapes can appear in the application and when the stability of the shape-parameters has been carefully evaluated. For shape features directly taken from image processing libraries it might be a good idea to look at the details of the methods used. Combinations of normalized, centered moments may show very good performance as shape-parameters. In addition, these features may be calculated for arbitrary clouds of pixels and are not restricted to binary objects as in blob-analysis.

Reference

[1] R. C. Gonzales, R. E. Woods, Digital Image Processing, Addison-Wesley, 1993, p. 516

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Global Player

What´s about Golf and Metrology?

Alicona is one of the leading suppliers in high resolution 3D optical measurement and inspection. The dynamic company impresses not only with the continuous extension of its product range. Also, the steady global expansion since the foundation in 2001 is remarkable. One of Alicona's subsidiaries is Alicona UK Ltd. We spoke with director Brian Kyte about markets, new developments, the economic situation and how optical measurement influences the golf court.

Brian Kyte, Director Alicona UK Ltd.

INSPECT: Brian, what are the key markets in the UK?

B. Kyte: Amongst others, Great Britain is particularly successful in the automotive sector and the aircraft industry. Our measurement solutions based on Focus-Variation meet both, the needs in terms of quality assurance and failure analysis in production as well as research and development activities. Our product range covers the requirements for high resolution, fast, easy and repeatable measurements of geometries with large components as well as sub-miniaturized samples. Key aspects of activities are mechanical engineering, failure analysis and the investigation of corrosive mechanics.

Alicona is also known for its strong emphasize on intense cooperation with international institutes. What kind of scientific projects are happening in the UK?

B. Kyte: We are a very well established partner of NPL, the National Physical Laboratory which is the national standards lab in the UK. It is a globally recognized knowledge centre for research and development and a service point for industrial customers. At NPL, InfiniteFocus in mainly used for measurement tasks in the field of tribology and corrosion. One of the projects being currently performed is the investigation of cutting tools´ hardness and its effects on durability, wear resistance and overall lifetime. Also, NPL acts a national demo facility of InfiniteFocus for interested customers.

Besides tribology and corrosion – what other future applications do you see despite the current economics situation?

B. Kyte: Our new developments make InfiniteFocus more and more to the ideal tool for the measurement of drills and milling cutters. We are now able to measure the complete structure of a tools´ surface in only one measurement. Due to the sample rotation of 360° we can also measure additional geometries such as relief grinding, flank and clearance angles or concentricity. This makes the instrument very attractive for all kinds of tool manufacturers. We have already noticed a significant increase of enquiries from manufacturers of surgical instruments. Another substantial progress in the medical sector is the progress being made in terms of measuring all kinds of implants such as hip or tooth prostheses. This is due to the new form analysis which enables the user to measure form deviations of surfaces. Again, the automotive industry benefits as well since the technique allows precise and easy measurement of complex forms, as of example injection valves.

At the beginning you mentioned quality assurance in production. Do you think that industries' requirements in terms of in-line measurement have increased?

B. Kyte: Absolutely! Inline measurement is not only a question of Go/No-Go status, it also targets the guarantee of highest quality in surface finish. This also includes the numerical verification of smallest component geometries which implies a high resolution measurement technique, also, repeatability and traceability have become more and more important. Another aspect that has to be met is the need of comprehensive documentation and data management. Yet another aspect that needs to be taken into account is the need of optical measurement as it is contact and wear free. InfiniteFocus meets all these requirements: it is a dense measurement technique with up to 100 million measurement points which provides the high vertical resolution of up to 10 nm even on larger geometries. It is optical and therefore free from wear, it measures smallest dimensions and tolerances including the deviation to a CAD model and achieves repeatable and traceable measurements. Typical applications for InfiniteFocus in-line measurements are damage analysis of e.g. engine blocks or aircraft turbines or inline solder pad checking. In these applications the sensor is either integrated directly in the production line or mounted on a robot to access difficult positions.

Brian, before we started the interview you told us you are a passionate golfer and that golf club manufacturers will shortly undergo a change in terms of new regulations. Why is that a matter of 3D measurement?

B. Kyte: In 2010 the Royal Ancient Golf Society will publish new guidelines for golf club faces and grooves. This is to ensure that all golfers use a standard of equipment on professional tours that does not give them any competitive edge. The crucial area of the face is the radius between the groove and the face of the club. With InfiniteFocus those crucial parameters can be measured automatically, which eases the measurement task significantly and saves furthermore time and money. This success has already been instrumental in the supply of InfiniteFocus for many golf club manufacturers.

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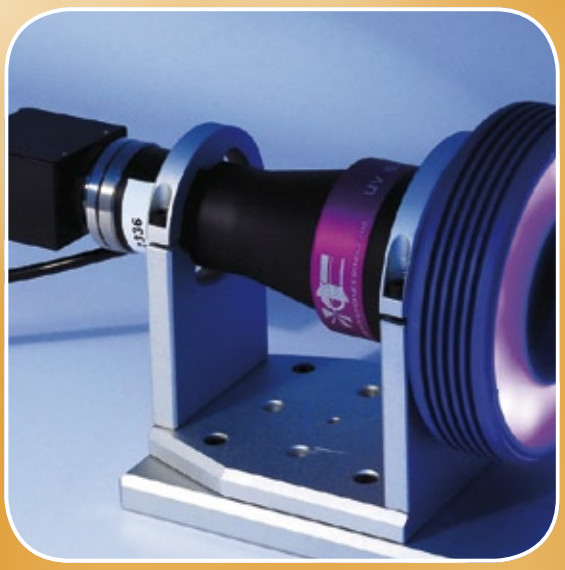
INSPECT

Vision



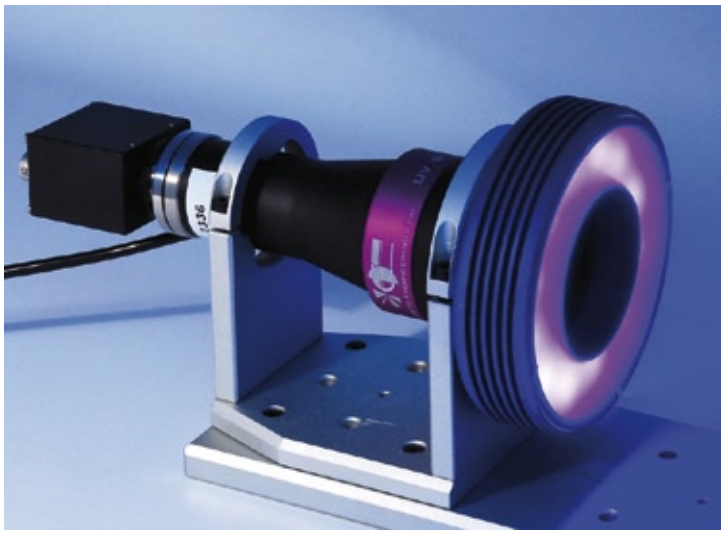
VISION: COMPONENTS AND TECHNOLOGIES

The Vision section of INSPECT deals with new trends in the camera market, changes in frame-grabbers, the wide range of lenses, the rapidly increasing variety of illumination as well as with the increasing use of smart cameras, vision sensors and compact systems. Software, with its facets of algorithms and user guidance as well as data processing and communication has its platform in the Vision section. In addition, the „hidden heroes" such as interfaces, processors and cables are taken out of the shadow and their effect on the success of the equipment as a whole is given appropriate editorial attention. The Vision section is addressed both to readers who plan the in-depth technical details of systems, as well as to users for whom Plug, Play & Forget is the primary aim.

High Accuracy in UV

Telecentric UV Lenses for Highest Image Resolution

Common machine vision lenses and traditional telecentric lenses operate in the visible light range. Machine vision integrators, since now, have been using these optics because they want their camera to see what their eye is able to see. Unfortunately this approach shows some limitations when applied to systems where very small pixel size cameras are used in order to achieve very high measurement resolution.

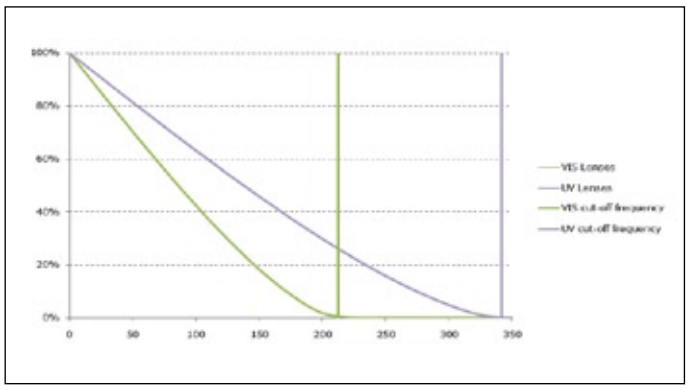


UV Telecentric Lenses make useful tiny pixel sizes and feature automatic optical edge exctraction

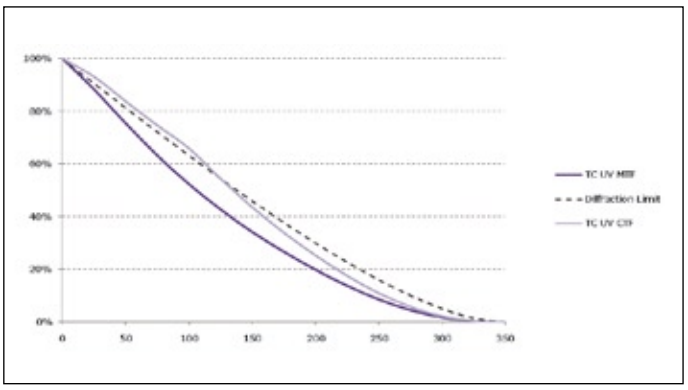
The limiting resolution of a lens is given by the cut-off frequency, the spatial frequency (line pairs/mm) at which the lens is no longer able to yield image contrast information. As the cut-off frequency is inversely proportional to the light wavelength, common machine vision lenses and telecentric optics operating in the VIS (visible light) range are useless with very small pixel sizes, e.g. as small as 1.75 micron, which are becoming increasingly popular among industrial cameras.

For this reason Opto Engineering has developed a new family of telecentric lenses operating in the UV (TCUV Series) which have been specifically designed to ensure the highest image resolution achievable today with a machine vision system.

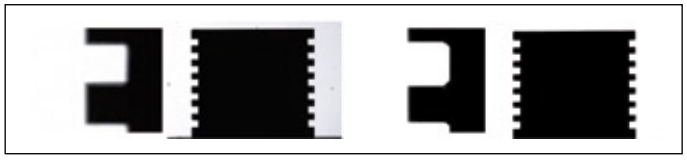
UV telecentric lenses can efficiently operate with pixels as small as 2 micron and for this reason these lenses can be successfully used in all those applications using very high resolution cameras and seeking for the highest possible system accuracy.



Limiting performances (diffraction limit) of two lenses operating at working F-number 8. The VIS lens operates at 587 nm (green light) and the UV lens is operating at 365 nm. The MTF function, which expresses the contrast ratio, is much larger at high spatial frequencies in the UV than in the VIS range. The vertical bars show the cut-off frequencies of both lenses: with UV lenses at 340 lp/mm contrast information is still theoretically present and pixels as small as 1.5 micron can bear significant image information



Resolution specifications of TC UV lenses. In addition to the MTF diffraction limit, both the MTF curve of TC UV lenses and the CTF (Contrast Transfer Function) curve are displayed. MTF curve refers to the response of the lens to a sinusoidal pattern, while the CTF function expresses the contrast the lens is yielding when a "square wave" pattern made of black and white stripes is imaged. If w is the spatial frequency and p is the pixel size, then a pixel whose size is p = 1/2w will yield a contrast given by the CTF at the spatial frequency w



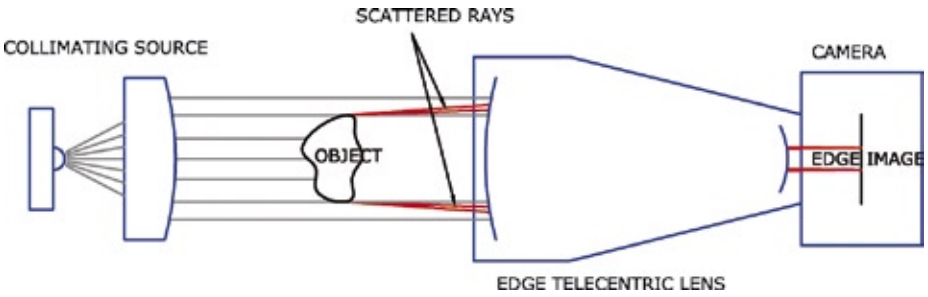
Images of back illuminated object edges are shown. On the left the objects are observed by a lens operating in the visible range. On the right the same images taken with a TC UV telecentric lens. With TC UV lenses the black/white transition takes place in less than a pixel (in this case 3.5 micron)

These lenses, by operating in the 365/425 nm range, provide much higher image contrast at high spatial frequencies and are therefore compatible with the smallest pixel sizes. On the other hand, used in combination with normal cameras, the resolution of these lenses is so high that they can tolerate object displacements much larger than VIS lenses before any image defocusing becomes evident. Therefore the field depth is also increased when compared to standard, VIS-operating, telecentric lenses.

UV telecentric lenses can work with any kind of UV illuminators operating in the 356 ... 420 nm range, like ring, coaxial and back light illuminators equipped with UV LEDs. However, the best choice for measurement applications are LT-CLUV LED Collimated Illuminators providing image resolution and field depth enhancement. These telecentric illuminators ensure an extremely efficient coupling between the UV LED source and the UV telecentric lens by back-lighting the object with the most appropriate geometry. With this very efficient configuration UV enhanced detectors are not needed while any CCD or C-MOS camera can be integrated.

UV telecentric lenses combined with a proprietary optical technology developed by Opto Engineering are providing the unique imaging technique, TC Edge, which ensures that only the rays deviated by an object's edge are imaged on the detector plane.

Edges are automatically extracted by the lens system without any need of software algorithms; this technique makes it possible to enhance very small defects, particles and surface discontinuities which cannot be viewed by any other type of lens system.



Working principle of an UV LED collimating source coupled with a lens integrating TCEdge technology: only rays scattered by the object edges are collected and imaged by the lens, while all the rest of the field of view area remains black

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New Opportunities of Machine Vision Software

How Newest Machine Vision Technology Helps Users

With its new version 9.0, Halcon offers valuable speedups: especially Halcon's exceptional automatic operator parallelization has been speeded up considerably and thus significantly increases the benefit of multi-core computers. Furthermore, Halcon 9.0 provides unique new matching technologies to robustly and reliably find objects or work pieces even in images with perspective distortions.

In addition to improvements of the well established matching and 3D vision techniques, Halcon 9.0 most notably offers a considerably enhanced usability. Moreover, from now on extremely large images of more than 32k x 32k pixels can be processed. And data codes can be read by Halcon 9.0, even if important parts are missing.

GPU or Frame Grabber?

The possibility to outsource out image preprocessing to the computer's GPU is much discussed. But for practical use, it does not make any sense. Indeed, on GPUs processing steps can pass off in high speed, but no currently available hardware enables the data transfer fast enough. Thus, in reality every application is decelerated by the twice slow transfer times. Therefore, MVTec does not favor image preprocessing on GPU. But on a frame grabber, free computing capacity can be used without additional data transfer. Thus, Halcon 9.0 provides a Visual Applets interface that enables image preprocessing in real time with frame grabbers by Silicon Software.

However, with each software version MVTec primarily focuses on the speed increasing of the algorithms. With Halcon 9.0 not only the entire library speed was enhanced by 5 %, but also selected operators (gauss x 3.7; median x 27 for 16 bit gray values; normal gray value morphology x 11 for 16 bit gray values).

Conclusion: Image preprocessing should only be outsourced to a frame grabber, but not to a graphic card.

Fast Parallel Processing – Fully Automatic

Already with the rollout of the first machines which simultaneously provided multiple processors, MVTec developers picked up this opportunity. With version 6.0, Halcon provided as an option the special version "Parallel Halcon" equipped with the so-called "automatic operator parallelization" (AOP). Parallel Halcon was without any competition and primarily prevailed in high-speed applications.

Thus, MVTec was well prepared when a few years ago the first multi-core processors came onto market. The well established AOP occupied this multi-core technology and is now – with the version 9.0 – again speeded up by 20 %.

AOP automatically finds (without any actions of the programmer) the number of available cores. Afterwards, the image is also automatically split into sub-images and delivers these to a corresponding number of threads. After processing by the several cores, the computed data are automatically merged to achieve the result. With an increasing number of processors, also the speed continuously accelerates.

A further advantage: The programmer is able to pre-select a region of interest (ROI) as a free form in the image of any orientation. Thus, AOP only processes this area of the image, leading to a dramatically reduction of processing time.

Halcon not only parallelizes filters but also many other operators and methods that are important for a huge amount of industrial applications: This covers methods for matching, 3D matching, subpixel extraction, and FFT (fast Fourier transformation). In version 9.0, under AOP more than 400 operators run in parallel.

AOP also is able to process arrays of images in parallel as well as arrays of regions, caused by segmentation (e.g., OCR or blob analysis), and arrays of subpixel-accurate outlines.

However, parallelization only makes sense, if enough memory throughput is available; thus, the performance depends on hardware. Also in this case, Halcon 9.0 provides a solution: Halcon is able to automatically identify the hardware environment. Based on this ability, the software decides which algorithms will parallelize to avoid unnecessary overhead.

Moreover, AOP also processes multi-channel images (e.g., color images) with an unlimited number of channels.

Conclusion: Version 9.0 parallelizes industry-relevant filters, operators, and methods fully automatic and optimizes these operations. Non-automated multithreading is not able to supply this performance.

Matching for Perspective Distortions

Halcon's fast shape-based matching and component-based matching are widely known and unique. With version 9.0, now new matching technologies come into the market.

The descriptor-based matching recognizes perspectively distorted objects. It is based on the detection of interest points where gray values are clearly differentiated from neighboring areas (brightness, curvature, corners, spots). Planar objects such as prints with texture (fig. 1) can be located extremely fast in any pose and tilt.

The perspective, deformable matching recognizes perspectively distorted objects. Work pieces and objects with distinct edge and area accented elements such as a car door (fig. 2) can be identified by this method with highest accuracy, reliability, and robustness.

With version 9.0, the shape-based matching can optionally be used with an increased mode of tolerance. This significantly improves the robustness in finding objects. This option not only matters for out-of-focus images (a common problem during the inspection of electronic components) but also for matching objects that can differ in their outline to a certain extent.

Conclusion: Halcon's new matching methods provide worldwide uniquely new methods to the industry for perspectively distorted objects.

Comprehensive 3D Vision Helps Robotics and Inspection

Especially for robotics, machine vision becomes more and more important. In addition to established 3D technologies such as 3D object recognition, 3D camera calibration, binocular stereo reconstruction, depth from focus, and besides the two new matching methods for perspectively distorted objects as described above, the following new 3D methods are provided:

During stereo processing often the problem occurs that complete areas do not have any texture. To close this information gap, MVTec developed the multigrid stereo that eliminates the disadvantages of the conventional stereo method. After processing by multigrid stereo, the areas without information (fig. 3, left, dark areas) appear as proper edges and structures (fig. 4, right). Thus, multigrid stereo can bridge texture gaps in stereo images and delivers highly accurate results.

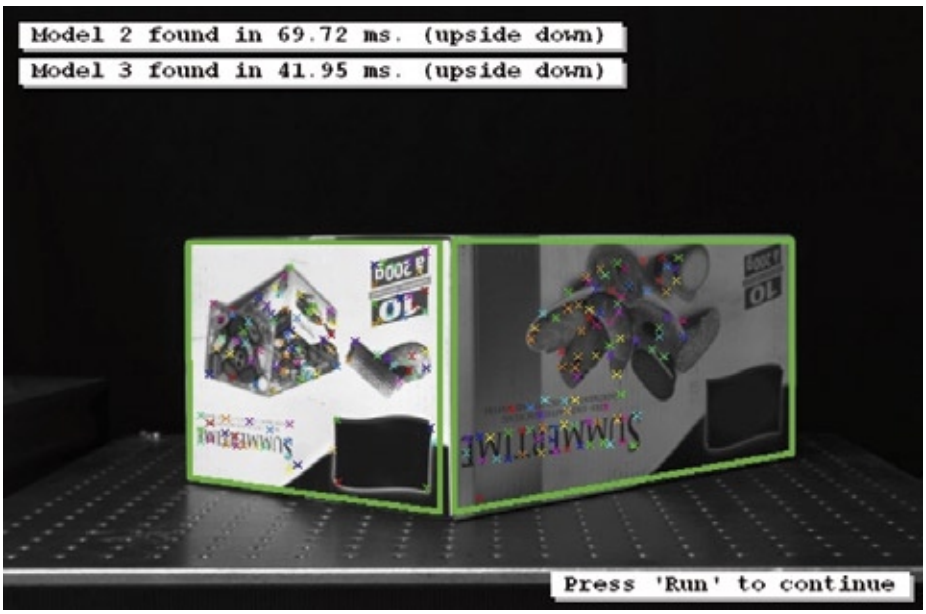

Fig. 1: The descriptor based matching detects perspectively distorted areas. For this, interest points are detected where gray values are clearly differentiated from neighboring areas (brightness, curvature, corners, spots).

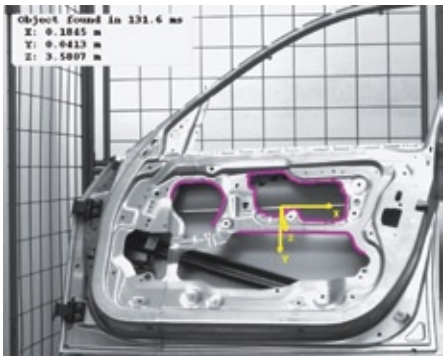

Fig. 2: The perspective, deformable matching recognizes perspectively distorted objects with distinct edge and area accented elements such as a car door.

Furthermore, the new version provides new operators for sheet-of-light measurement, which extracts projected laser lines and thus generate a 2½ D model.

The Halcon software provides unique 3D camera calibration. By this method, the interior camera parameters and pose are determined and pixel coordinates can be converted into world coordinates. Thus, robot control becomes easier. In Halcon 9.0, the underlying camera model for 3D calibration was enhanced to also eliminate complex distortions as well as alignment errors of the lenses. Thus, the accuracy of results of 3D algorithms, e.g., 3D matching or stereo, gets enhanced significantly.

Conclusion: Halcon 9.0 provides comprehensive solutions for all demanding 3D vision challenges.

Data Codes also without Finder Pattern

Data code reading is an increasing technology worldwide. Ideally, a data code consists of a dot print area composing the actual code and a frame for orientation and pose identification of the code, the so-called finder pattern. In practice, important parts can be damaged by transport and other mechanical influences, not printed, or overprinted. For usual data code readers, such a defect data code is often not readable. Now, Halcon 9.0 comes out with a data code reader able to read such damaged codes, even if the whole finder pattern is missing (fig. 4). The software reads ECC200, QR, and PDF417 of each size with elements of minimal 2x2 pixels.

All common bar codes can be read in any orientation, even with a bar distance of only 1.5 pixels. The Halcon 9.0 bar code reader was significantly speeded up and enhanced for all RSS codes (including composites).

Conclusion: The reliability and robustness during identification of bar and data codes was pushed to a unique maximum.

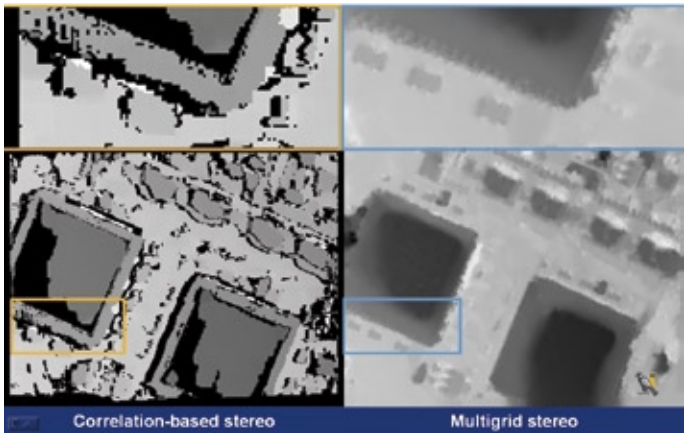

Fig. 3: By multigrid stereo, the disadvantages of the conventional stereo method are eliminated. After processing by multigrid stereo, the areas without information appear as proper edges and structures.

Processing Large Images

For a long time it was a desire of industry: Version 9.0 now processes large images of more than 32k x 32k. The size of images is not limited. Above all, this is interesting for high resolution line scan camera applications as deployed in print and electronic industries for print and component inspection. If this technology is combined with Halcon's fast parallel processing, in spite of the high data amount the desired real-time will be reached already without outsourcing image pre-processing. Thus, programming is significantly easier and faster and the application runs trouble-free.

Conclusion: From now on, large images can be processed trouble-free and with minimized effort. Thus, complex line scan camera applications run robustly, reliably, and accurately.

IDE with Enhanced Usability

Halcon provides a fully integrated development environment (IDE). This IDE called HDevelop was enhanced. Now, HDevelop offers a free text editor with advanced autocompletion. This feature significantly speeds up programming.

Moreover, HDevelop provides so-called assistants. The new assistant for camera calibration helps users to easily and accurately operate the camera calibration. After the camera parameters have been computed, the calibration assistant can be instructed to insert the corresponding calibration code into the HDevelop program.

From now on, all procedures that are newly developed by users are completely handled just like already existing Halcon operators, not only in regard to their documentation but also their appearance in HDevelop pull-down menus. This makes it very easy to document and seamlessly integrate newly developed procedures into HDevelop.

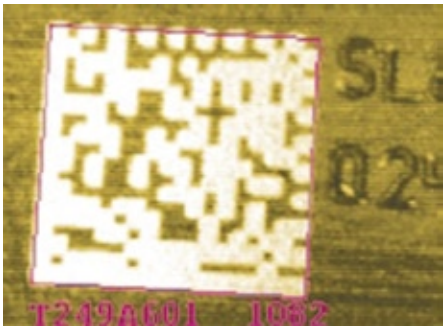

Fig. 4: The data code reader reads defocused as well as damaged data codes, even if the whole finder pattern is missing.

Halcon 9.0 comes with a huge amount of new source code modules and classes – Halcon codelets – that can be used outside the development environment HDevelop. Many of these modules as well as regarding example applications can be used as templates for new applications or directly called within newly developed code. Particularly, the Halcon codelets help to quickly and easily use enhanced functionality of the HDevelop graphical interface or the HDevelop assistants also outside of HDevelop.

Conclusion: All these programming aids and accelerators support the user to quickly implement an application and thus improve time to market.

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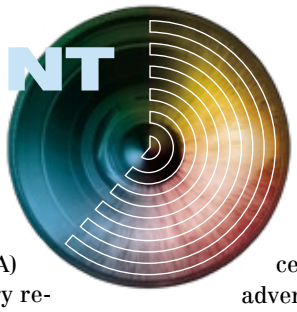
VIEWPOINT



Success Factors

Recently at the annual business conference of the American Imaging Association (AIA) I had the chance to enjoy a very refreshing presentation by Prof. Dr. Gérard Medioni of the University of Southern California: "Computer Vision: A Bright Future". As his introduction to the bright future of machine vision in various innovative applications Prof. Medioni choose to give an account of his own failures in the past. In the mid 1990s he had developed a technology whose presentation only recently was honored as "the most influential machine vision paper of the decade". What was it about and how on earth could something so highly recognized today have been a failure back then?

Billboard advertising of various products and services during sports events is a common practice. These billboards target not only the spectators at the stadium, but mostly the viewers of the national or even global TV broadcast of the event. The fixed billboard advertising is of course rather limited as soon as it addresses a very diverse audience with different product interests or in areas of different product availability. The development of Prof. Medioni made it possible to exchange the real billboard ad with a virtual one: in real time and based on the image content in each individual frame of the video stream. The system receives as input a TV broadcast signal, must identify a given billboard in the image flow, track it precisely, and replace it with another pattern (the virtual billboard ad), broadcasting the replaced signal, in real-time, with only a short, constant delay. This way the Dutch viewer sees the ad for Amstel beer during the World Cup broadcast, the German sees Warsteiner, the American Budweiser and the Russian Smirnoff ads on the same billboards in the same game.

In a nutshell: highly flexible possibilities for advertising in a very attractive setting with specific customization options. To say it in Prof. Medioni's words: "with such a concept how could you go wrong?" He envisioned himself already retired as a millionaire. But, instead of having the yacht mooring in attractive San Diego harbor, it was now only giving a presentation at a conference hotel next to the attractive harbor. What had happened?

With all the enthusiasm for the great technology and the exciting technical potential, Dr. Medioni seemed to have forgotten all about checking the validity of the business concept. By the time the virtual advertisement could have reached the target audience, the following parties wanted their share of the big bucks: the stadium owner, since his billboard was going to be used, sort of; the sports team, since they would be the real attraction for the viewer; the broadcasting company, since they would distribute the message. And the advertisement customer wanted to have a guarantee as to how often and how long their ad would be displayed during air time. This of course could only have been achieved by bribing the camera man …

Still, it could have been even possible to manage with all the additional cost originally not considered. The real killer for the project had been the fact that for each and every event with each and every of the different parties, and them changing from event to event, an individual contract would have to be negotiated. The only chance for getting rich in this scenario was for the lawyer of the innovative professor.

Dr. Medioni related this story in a very entertaining way and with a self-critical wink. The delight in this presentation was by no means one of gloating, it was more the joyful recognition of an old acquaintance: yep been there, seen that, experienced it myself.

For us enthusiastic innovative high-tech creators it is by no means of harm to be reminded every now and then that the best technology, the greatest idea, the most state-of-the-art features can only lead to economic success when integrated into a solid and critical appraised business concept. And this, the business concept, has then to be professionally marketed. And that, the marketing, cannot be downsized, especially not in times of slow economy.

This, in any case, is my point of view.

Gabriele Jansen
Publishing Director INSPECT
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New FireWire Bus Driver Package

Allied Vision Technologies has made a new IEEE 1394 bus driver available for its FireWire cameras, effective immediately. The driver for Windows Vista and XP (SP2/SP3) closes gaps in Microsoft's standard driver and enables much more efficient image data transfer. Windows' standard FireWire driver is fundamentally suited for the IEEE 1394a standard. Newer functions, especially higher data speed, that were introduced with the IEEE 1394b standard, have not been fully supported. For this reason, devices with a 1394b interface cannot take advantage of full 800 MB/sec bandwidth, for example. Adding to this deficit are stability issues that are unacceptable for industrial and professional applications with high reliability demands. The new AVT 1394 bus driver eliminates the speed limits of the original Windows driver.

Allied Vision Technologies GmbH
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JAI Unveils 16 Megapixel Camera

The company added a new 16-megapixel high performance CCD camera to its multi-tiered C3 Camera Suite. This new progressive scan camera incorporates the Kodak KAI-16000 dual-tap sensor to deliver full 4,872 x 3,248 pixel resolution at three frames per second. The new high resolution camera is available in two models: AM-1600CL (monochrome) and AB-1600CL (raw Bayer color). Both models feature Camera Link interfaces offering user-selectable 8-bit, 10-bit, or 12-bit output. As a member of the Advanced tier of the C3 Camera Suite, JAI has designed the camera to be both high performing and highly reliable. A series of pre-processing functions are built into the camera to achieve high image quality while offloading these tasks from the user's host PC.

JAI A/S
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Modified Lenses for Industrial Applications

The line of SLR lenses from Carl Zeiss for industrial applications has now grown to seven models. Thus, a complete line of lenses is now available which offers the right solution for most standard requirements in industrial applications. The modern optical design of these lenses with fixed focal lengths ensures maximum image quality. Professional industrial applications require reliable, constant settings. Therefore, the ZF lenses are available in a special industrial version. The f-stop and focus settings of the ZF-I lenses can be fixed. For this purpose, the lenses are supplied with five locking screws which enable reliable locking of the adjustments once they have been set. Measuring inaccuracies and errors are thus reduced, and there is no need to waste time checking the settings.

Carl Zeiss AG
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www.zeiss.de

CompactBox with Extended ATX-Motherboard Possible

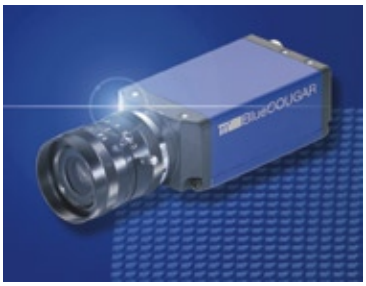
Just in time for the "Embedded World" fair, the Box-IPC's family has grown. One great advantage of BEG Bürkle's new CompactBox is the possibility of optionally applying an extended ATX motherboard.

System enhancement up to 7 slots at full installation length and height is made possible. Either AMD-Athlon processors or alternatively Intel Celeron Core 2 Duo or Core 2 Quad processors are built in, according to requirements. If one needs an exceptionally fast and powerful computer, Intel's new Xeon processor will well meet the expectations. With it image- and videoprocessing or complex projects can easily be realized. Up to two 3,5" Deskstar P7K500 HDDs by Hitachi can be build in. Due to their 250GB capacity they provide proper space and allow the computer to be run 24/7.

BEG Bürkle GmbH & Co. KG
Tel.: +49 7032 2012 0 • info@ beg-buerkle.de • www.beg-buerkle.de

New Variants with 2 and 5 Megapixel CCD Sensors

Matrix Vision upgrades the mvBlueCougar-S Gigabit Ethernet camera series and offers two new variants with 2 and 5 megapixel CCD sensors. The first one is called mvBlueCougar-S124 and has a CCD sensor with a resolution of 1620 x 1220 pixels (2 megapixels) and a frame rate of max. 30 Hz. The second one's name is mvBlueCougar-S125, which has a CCD sensor with a resolution of 2448 x 2050 pixels (5 megapixels) and a frame rate of max. 16 Hz. Both CCD sensors are available as gray scale and color versions. All color versions of the series execute Bayer demosaicing onboard directly. After acquisition, the image data can be transferred as RAW or RGB alternatively. Like the existing variants, the new ones offer one digital input and one digital output for trigger and flash as well as a C-mount lens holder.



Matrix Vision GmbH
Tel.: +49 7191 9432 0 • info@matrix-vision.de • www.matrix-vision.de

New Software Announced

Cognex announced new software that expands the decoding capabilities of the DataMan 100 vision-based ID readers and provides additional code support for all models in the DataMan product family. With the new software release 3.2, DataMan 100 fixed-mount ID readers can now simultaneously read up to 128 codes in a single field of view – even with mixed code types – opening up many new application possibilities. In addition to the new multicode feature for the DataMan 100 Series, release 3.2 provides improved performance on all DataMan models for QR codes having perspective distortion, especially with high-contrast labels. The 3.2 release also includes support for VeriCode for customers who purchase a license key from Veritec.

Cognex Germany Inc.
Tel.: +49 721 6639 252 • info@cognex.com • www.cognex.com

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european machine vision association

EMVA Business Conference 2009

7th European Machine Vision Business Conference
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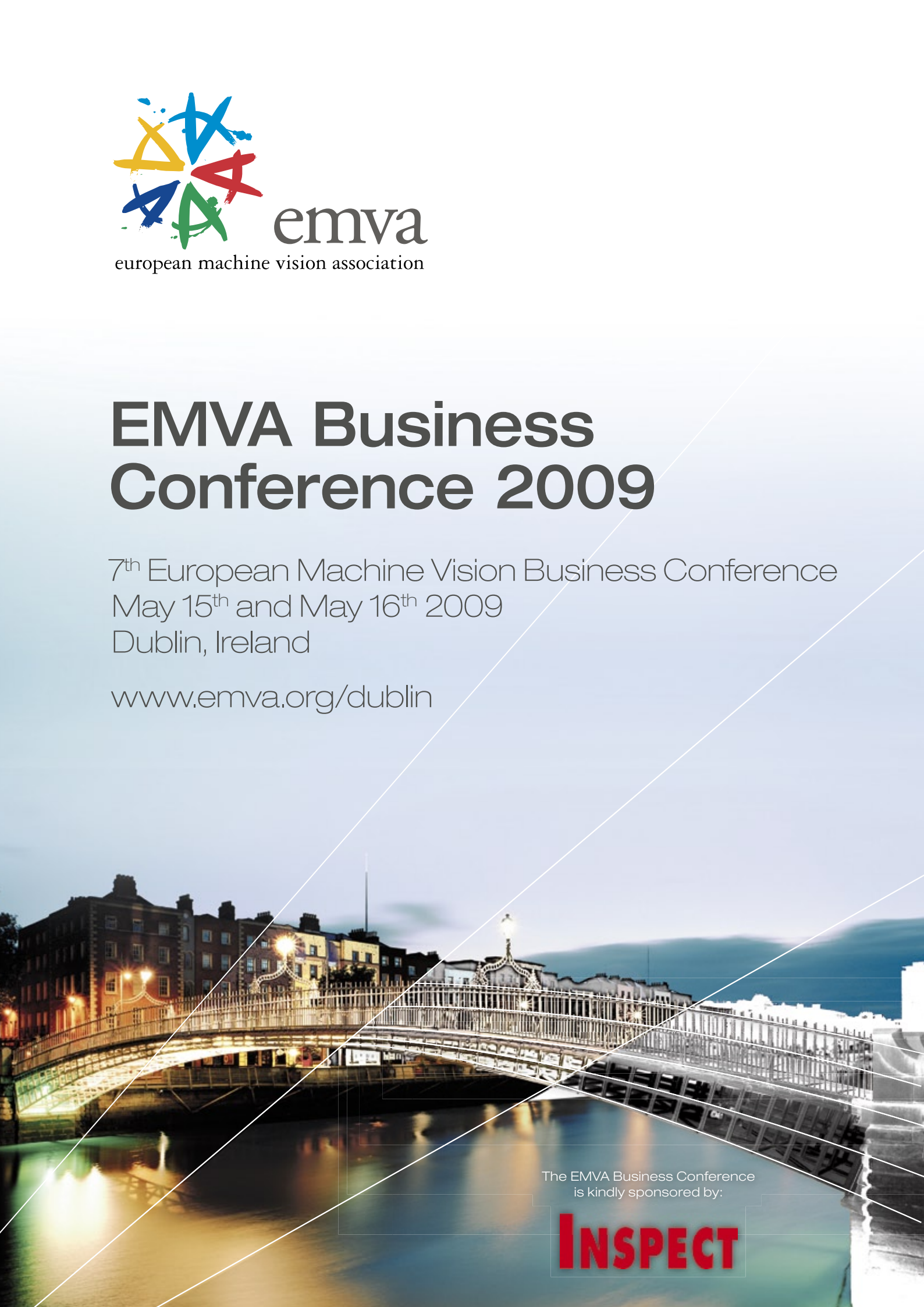

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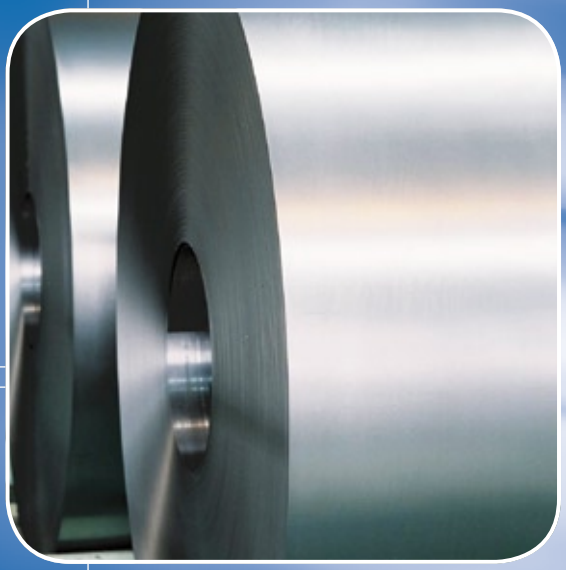
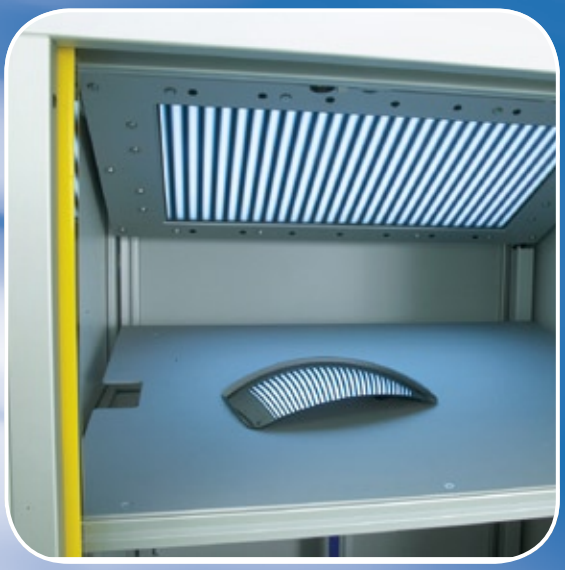




AUTOMATION: MEASUREMENT – INSPECTION – IDENTIFICATION – GUIDANCE

The Automation section features turn-key systems and applications. 3D robot guidance in automotive assembly lines is a topic which is just as important as the quality control of wine bottles in Napa Valley. Surface inspection of webbed material in glass, plastic, metal and paper production, inspection of print quality in the printing industry or on cans of tuna, inline dimensional checks of entire car bodies – these are all topics you will find in the Automation section. Success stories with testimonials from users show not only the performance of technology in various fields, but also guide you to suitable suppliers for your application.

Source: Flickr, Dan

Graded Quality

Machine Vision for Textile Inspection

Textiles are produced in many forms and for a wide variety of end uses including automotive, aerospace, military, recreation, construction, home decoration, insulation and apparel. Each end user will have specific criteria and requires functionality, often uniquely satisfied by a combination of textile properties.

Although there are many textile performance tests conducted on laboratory samples, a full surface area visual check by human eyes is traditionally the main method used to detect overall functionality and aesthetic appearance.

In most cases manufacture of a textile fabric is part of a multistage process to arrive at a final product, of which the textile fabric would account for a small proportion of the total costs. An extreme example is textiles used for automotive interiors where the aesthetic appeal and wear characteristics are a critical part in achieving the overall appeal of a vehicle in a showroom and so the perceived value of the vehicle.

The consequences of a visible defect being missed during manual fabric inspection and ending up in a vehicle component (seat, headliner etc) are costly. The scale of the cost depends on how far the defective component has reached in the overall assembly process before discovery, as greater value is added at each stage and the cost of replacement increases the closer the completion of the vehicle. This is a particular problem for the textile producer as much of the wasted value added costs are claimed in compensation from them by their customers.

Keeping an Eye on Quality or …

Traditionally, textile inspection has been performed in two areas in a production plant. The machine operators will 'keep an eye' on the product as it goes through a production process. They are not, however, inspecting all of the product all of the time. With production speeds sometimes exceeding 100m/min they may only be aware of gross defects and in some cases these are also missed.

A further detailed inspection is then carried out off line and frequently at a significant time-lapse period from manufacture, which means repeating, process induced defects are not detected until this later stage. The detailed inspection is performed at slower speeds and several inspectors are required to keep up with production rates. This introduces the problem of variation between inspectors in addition to variation in the standards applied by an individual inspector from day to day.

The position of a Shelton WebSpector system in a textile production process is not restricted as it is for manual inspection

… 100 % Attention on Quality

The solution is an inspection system with 100 % attention that can cope with full production speeds and apply consistent and auditable quality standards at the point of manufacture. This real time quality feedback can be used to identify defects and prevent them getting through to a customer and to provide information to machine operators to reduce the reoccurrence of faults.

Shelton Vision Systems has applied considerable expertise from the multi-faceted disciplines of machine vision to overcoming the unique demands of textile inspection and have developed an off the shelf, multi application inspection system, Shelton WebSpector, capable of providing a cost effective solution for all textile demands, from simple plain cloth for basic apparel to critical safety or performance cloth for parachutes, airbags and automotive end use including car interior and transmission belts.

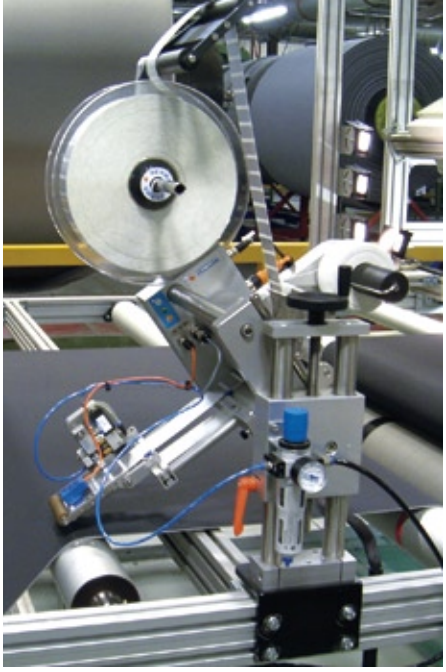
Grading Quality

In most textile manufacturing businesses there is a vast, ever changing range of products, whether driven by fashion or performance demands, as well as shorter production runs of each style or design.

To ensure accurate and repeatable defect detection it is necessary for the system to 'understand' what the perfect product should look like, therefore a vital feature of the Shelton WebSpector system is an unsupervised, self teaching function that calculates and then stores accurate operation settings for each style.

As well as a large range of products, textiles are subject to many causes of defects that originate from raw material, manufacturing processes and applied additives. The severity of a defect from the same origin can vary, so the system is capable of defect grading within a defect class, as well as classification between different types of defect. This has to be

The inspection system can cope with full production speeds and apply consistent and auditable quality standards at the point of manufacture



The WebSpector records a full surface area scan at full system speed that can be 're-played' through the system software as if the actual fabric were being re-run

done in real time, as decisions need to be made as to whether the feature is a defect, if so what type and then the severity, before instructing a label to be applied at line speed.

Grading allows filtering of inconsequential defects of a certain type whilst recording more severe examples and classification provides a clear distinction between defects of differing causes that may appear visually similar. An example of classification in operation would be for the system to understand where a piece of fluff is loose on the surface of a fabric as opposed to a piece of fluff that has been entangled within the fabric construction. The former is a defect, the latter of no consequence.

In-process versus Final Inspection

The location of a Shelton WebSpector system in a textile production process is not restricted as it is for manual inspection. It can be positioned in harsh environments and operate at speeds many times faster than is humanly possible. The range of financial benefits broaden the further into the process a system is positioned and in some cases it may be of benefit to have in process inspection as well as final inspection.

In process inspection means re-occurring defects can be kept to a minimum so reducing scrap, re-processing costs and wasted added value, whereas accurate final inspection prevents customer claims, (for non marked defects, shortages, lost production time), the costs of re-supply (often with the added cost of airfreight) and where an open supplier/customer relationship exists, avoids the need for duplication of the inspection process by supplier and customer. In fact remote on line access for a customer can be provided for inspection results and the actual inspection process if desired.

Defect Map and Recording

Most textile fabrics are produced in batch from 50 to thousands of meters in length. The WebSpector not only produces a detailed electronic defect map for the whole batch length, showing defect type, position, severity and a thumbnail image, it also records a full surface area scan at full system speed that can be 're-played' through the system software as if the actual fabric were being rerun. This enables accurate performance validations and auditing, a way of objectively setting standards and dealing with obscure defects and having a solid defense against doubtful claims from customers.

The benefits derived from having an accurate defect map of a complete batch in electronic form is that it can be processed an optimized cutting plan for splitting it down into small rolls for units of sale. Rules for the desired roll length and tolerances, defect allowance and other variables are entered into a cut plan software function and within a few seconds an optimum yield is calculated and the cut plan generated. The cut plan can then be fed into an automated, or operator assisted, high speed re-rolling machine to automate the splitting into small rolls. The cut plan function provides waste savings compared to manual cutting of >1 % and the re-rolling throughput is increased by up to 500 %.

ROI after 6 to 18 Months

The Shelton WebSpector is connected via the internet for remote support on line and is offered on contract rental plans or outright purchase. This flexibility of access means ROI is between 6 to 18 months and allows textile companies to raise their profile in terms of quality and performance within a competitive market place.

This is well illustrated in the garment value chain of supply for apparel sold in high street stores. In this scenario the data generated by the fabric producer at the final inspection stage can remove unnecessary costs incurred at all points in the garment value chain, from fabric producer through garment making to retail. If the textile producer does not ship the correct quantity of useable fabric due to variable manual inspection then the costs incurred down the value chain escalate. By having the ability for on line sign off on a shipment even before the fabric is cut into small rolls by the textile producer, a fabric user and/or retailer, has the potential to save severe consequential and irrecoverable losses.

In conclusion the application of machine vision to textile inspection processes unlocks a wide source of financial benefit and opens the way for closer supplier/customer information sharing that results in mutual process, product and environmental advantage.

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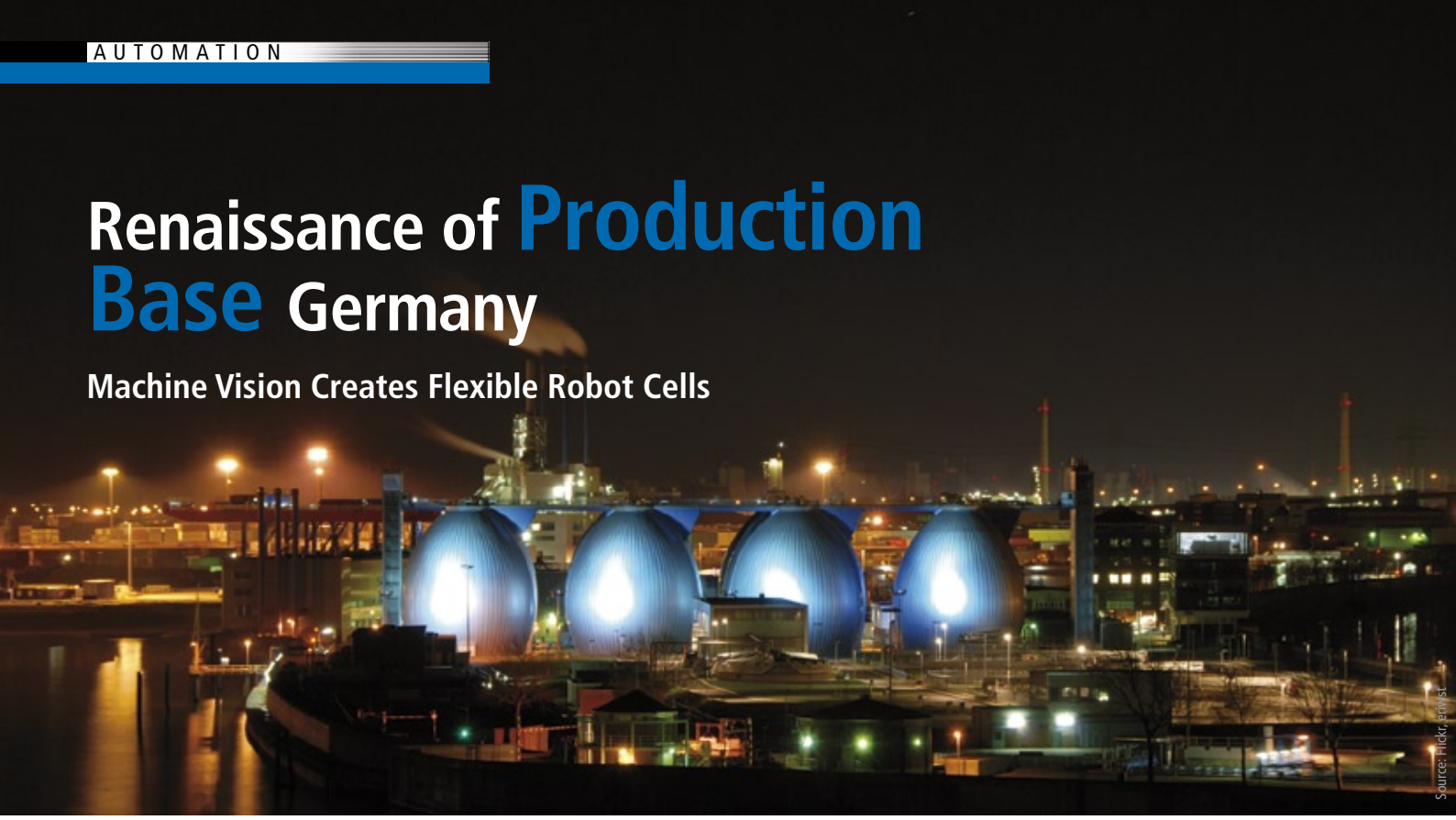

Source: Flickr, gerwyst

In the past many companies have already transferred their production abroad. It has been a positive experience for some, but many others have had their fingers burnt. Increasingly, those in charge are starting to reflect on the advantages of basing production in their home country and are doing a U-turn.

Things are so much easier when you know the local regulations, conventions, mentality and language. When you are at home, you are also less likely to be taken unawares by unfamiliar laws and procedures. Your existing networks, the close proximity to customers, the short transport routes and the resulting increased flexibility represent key advantages, as does the fact that employees are highly trained. The bar is constantly being raised when it comes to modern and efficient production and these factors can all help you rise to the challenge. However, if you want to remain (or become) top dog in what is a fiercely competitive environment, you need to go the extra mile. This calls for flexible and versatile solutions that do justice to your product range over the long term and are as future-proof as they possibly can be. A good number of these solutions revolve around image processing in conjunction with robot systems.

It is against this backdrop that Frank Götz, Managing Director of rbc-robotics, has decided to focus on flexible, user-friendly solutions. These are the kind of solutions that are not tied to the latest version of the product concerned. We are talking about systems that only require the minimum of adjustments before they are ready to use with other products and about solutions that offer consistently high levels of quality thanks to the elimination of subjective influences. Smart planning and lateral thinking can be used to tap into hidden potential, which can be utilized within the context of many solutions at "no extra cost". Together, these various aspects make it possible to offer customers an attractive and competitive price-performance ratio and boosting the efficiency of their production at the same time.

Productivity Increase by Fast Part Feeding

Parts supplied as bulk material in a crate need to be fed automatically to a rapid process (e.g. 30 parts per minute). To achieve the desired output rate, not only is it essential to ensure that blanks remain constantly available, but also to ensure pin-point accuracy when placing them. It is also very important for the solution to be suited to a wide range of parts.

The parts are moved in single layer into the position underneath the camera by the tipper and the loop of the Multiflex compact feed system. Any parts detected as being within reach are processed and

The parts are moved in single layer into the position underneath the camera by the tipper and the loop of the Multiflex compact feed system

placed inside the press; the others are returned. The parts are fed automatically in rapid cycles. Deburring presses are loaded in cycles of two seconds and are responsible for deburring the parts following reshaping. The straightforward design results in a fault-tolerant solution for managing a wide range of part geometries. To locate the exact grip position, the image processing system makes use of features that are completely different, and therefore distinguishable, from the visible burr. The system developers managed to design the discrimination features so that even the customer's own employees would be able to teach in new parts in less than

10 minutes, which is extremely important given the large variety of parts of over 100 types. Due to the fact that cast parts are difficult to grip accurately because of their special properties, gripper solutions were devised for specific product lines.

Communication with the deburring press takes place via a standardized interface to make sure that everything runs smoothly. Thanks to the automatic loading feature, productivity has been increased by approximately 30 %.

Optimal Utilization of Machining Centers

Production managers will be familiar with the scenario outlined below: It takes three minutes to machine a part, for example, but the loading and unloading process lasts for approximately 10–20 seconds. This results in a delay of approx. two and a half minutes for the system operator. To make the most of this delay, he or she is often assigned responsibility for a number of machining centres. However well-intentioned this approach may be, in many cases there is no way of avoiding downtime on individual machining centers while they wait for the loading or unloading process to be completed (because of spatial conditions, faults, etc.). Consequently, the machining centers are often only used to around 60 % of their full potential. This calls for intelligent and flexible solutions that free up employees and increase the rate of utilization.

rbc-robotics customers are able to solve this problem using the Feedline concept. An employee loads the buffer with parts in the grip position. After a few moments, the employee is free to perform other tasks and tend to other machines. The machining centre is capable of running autonomously for long periods. There is an image processing system for detecting the position and orientation of the parts. As soon as the machining center has finished, a change of parts is performed. While the machining center is busy doing the machining work, the robots frequently assume responsibility for additional tasks such as palletizing the machined parts, blast cleaning, brushing and making parts available for subsequent production steps, etc.

A machine vision system detects position and orientation of cylinder heads for the automatic loading and unloading of machining centers

Depending on the configuration, it is also possible for two machining centers to be loaded with different parts by a single robot.

The image processing system can be set up easily in just a few user-friendly steps: pick up reference part, define characteristics, determine grip position, define collision range. Since this whole process takes only approximately 10 minutes per part, even parts involving small batch sizes and short running times of as little as three hours are perfectly manageable and the machining center's utilization rate can be increased to > 90 %.

Experience has shown that the Feedline concept frees up approximately 75% of the relevant operator's capacity for other tasks. It is even possible for the employee to place parts that are sensitive or prone to jamming on the Feedline concept's buffer conveyor. This reduces the requirements in terms of part supply, means that a wider variety of parts can be machined and increases the efficiency of employees by freeing them up.

Grip from the Box, but Layer by Layer

Parts can only be removed from a crate/from a pallet by using advanced image recognition technology, although many people think it is a question of simply "gripping from the box". In our opinion, such a solution viable from a production perspective is still very much at the experimental stage and may never be suitable for universal use.

The systems being investigated are subject to restrictions in terms of their ability to locate and access grip positions (particularly in the vicinity of the crate wall) and in terms of their ability to clearly identify a part when a large part of its surface is covered up by other parts. Systems such as these, which require operator intervention, cannot even be considered due to these kinds of restrictions. Another major weakness is the output rate, which is frequently up to 30 seconds per part. This is simply not good enough for many applications and means that the whole point of the automation process has been missed.

The PalletPicker locates and removes layered parts in a reliable way that meets the needs of the production process at a high output rate of up to 30 cycles per minute

The only realistic and feasible solutions are those that are capable of removing layered parts in a reliable way that meets the needs of the production process (even if such parts have become dislodged during transportation) and of offering a high output rate of up to 30 cycles per minute. It is precisely for this purpose that the PalletPicker from rbc-robotics was designed. Dislodged parts are located by means of image recognition technology. The coordinates are sent to the robot together with height data so that it can pick up the parts reliably. Even solutions for removing interlayers made of cardboard or plastic are widespread. While the production machine is busy doing the machining work, the robot is also able to perform additional tasks. For example, finished parts are often placed back onto pallets after the machining process.

The solutions described here illustrate how potential can be tapped within a production context for the purpose of creating a competitive advantage. The current climate, where production is slack, offers an ideal opportunity for planning the optimization of the production processes. Companies that decide to take advantage of this stand to benefit from the next economic boom in terms of having production based in their home country. The experts at rbc-robotics support their customers by identifying any untapped potential and finding practical solutions for their challenges.

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Sensor+Test Conference 2009

This year, the conference events to take place parallel to the Sensor+Test measuring technology fair will be held for the first time under a consolidated program: the Sensor+Test Conference 2009. The comprehensive conference program comprises the Sensor 2009 (chaired by Prof. Dr. R. Werthschützky, Technische Universität Darmstadt, and Prof. Dr. R. Lerch, Universität Erlangen-Nürnberg), the OPTO 2009 (chaired by Prof. Dr. E. Wagner, Fraunhofer-Institut für Physikalische Messtechnik IPM, Freiburg), and the IRS² 2009 (chaired by Prof. Dr. G. Gerlach, Technische Universität Dresden), as well as further top-notch conferences.

The agendas for the individual conferences are now available. All conferences start on the first day of the fair with a joint opening speech by Prof. Dr. G. Sessler, the inventor of the electret microphone and recipient of numerous international awards. Also, the Sensor Innovation Award of the AMA Association for Sensor Technology, endowed with €10,000, will be presented during the opening ceremony.

The Sensor Conference, to be held this year for the 14th time, offers an attractive and comprehensive program. Numerous topics relating to sensorics – from sensor development to applications in electronics and communication – will be discussed in 23 sessions. In a poster session on the second conference day a total of 41 research and development teams will present their results. Optical technologies are the focus of the Opto conference, held on the first two conference days with four presentations and a poster session. The emphasis is on interferometry and fiber sensors. Applications based on optical technology, for instance in quality assurance, will also be dealt with. The agenda for the IRS² conference consists of 16 presentations and nine posters on infrared sensors, pyrometry, and spectroscopy, as well as applications using gas sensors.

Included in the Sensor+Test conference program are further interesting events, such as the Forum for Microsystem Technology, chaired by Dr. H. Strese, VDI/VDE Innovation + Technik. The forum will be used to present current developments in autonomous sensor system networks and sensors for smart systems.

"The top-class scientific conferences, the Sensor+Test fair, and the action program ideally complement each other," says Holger Bödeker, Managing Director of the AMA Service. "With these conference agendas, we can offer the experts in sensor, measuring, and testing technology a truly interesting overall program, which exceeds anything expected at a normal fair."

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Defects Fast Recognized

Making Chatter Marks Measurable

Process stability is critical in rolling mills. Maintenance and monitoring of the technology used is therefore a high priority Where monitoring is not carried out, production shut-downs due to defective parts can result in significant costs. However, general wear of components cannot be avoided. Defective roller bearings, for example, are subject to wear. Knowing which roller is operating with a defective bearing can be very time-consuming to detect. A deflectometry principle used by sensor specialist Micro-Epsilon Messtechnik can now assist companies in monitoring roller bearings.

Metal strips must satisfy high quality requirements. Shadow formation due to chatter marks is not desired

In order to cold roll metal strip with the desired thickness from slabs, various stands with different rollers are required. Due to the laws of physics, the rollers at the end of the rolling line turn faster than at the beginning, since the strip is thinner and longer towards the end. Therefore, each roller has a specific speed. If the bearing on a roller is defective, it begins to make "chatter" noises. This non-spherical shape of the roller is due to the defective bearing and leaves traces on the sheet, so-called chatter marks. These marks are hardly visible to the naked eye. A striped pattern across the sheet can only be recognized under a certain angle of light. These light/dark transitions indicate an undulation of the strip in the micrometer range, which are the result of in-line variations.

The mechanical quality of the metal strip is not significantly affected by these chatter marks; nevertheless, they do indicate an error in the process, which must be rectified for in order to achieve process stability. If these errors are not detected, process stability is endangered due to the defective roller bearing(s).

Multiple different rollers makes it difficult to define at exactly which point the chatter marks are produced, which means it is also difficult to find the defective roller. Defining exactly which roller is responsible for the effect requires a measurement of the distance between the chatter marks. If this distance is known, the speed of the strip can help to locate where the effect is occurring. If the roller speeds and the strip speed in the process are known, the error can be localized using this information.

The problem here is that the chatter marks are hardly visible to the naked eye and so cannot be measured easily. In addition, a high-precision measurement of the distance is required for an exact definition of the position.

This task can be accomplished using the deflectometry principle. A sine-shaped light/dark pattern alternating in its position is reproduced on an industrial design TFT display. Cameras record the image reflected from the surface of the measuring object and transfer the

Picture of a metal strip. The light/dark transitions are called chatter marks

data to an industrial PC for evaluation. The recorded mirror images are further processed and evaluated in the computer in several CPU-intensive operations. Distortions of the reflected image, which indicate differences in the curvature of the surface, are used for the evaluation. Although the sheet shows undulations of only a few micrometers due to the chatter marks, the characteristic curvatures of the surface can be evaluated using this technique. The distance between each curvature peak represents the distance of the chatter marks. If the measurement system is calibrated to the target, the size of each pixel is known. Therefore, the distance between two chatter marks is determined with micrometer precision.

Turnkey Measurement Solution

The reflectControl system developed by Micro-Epsilon is very well suited to this task. A section of the metal strip is sufficient to measure the distance between the chatter marks. This is inserted in the RC-compact system. The system is designed for smaller measuring objects and for laboratory operation with fixed measurement systems. The target is measured without contact and the result is available within a matter of seconds.

Dipl.-Ing. Hannes Loferer, Surface Technology Product Manager at Micro-Epsilon explains: "Often, the brushed surface of the metal causes relatively high noise in the measurement data. Due to the two-dimensional measurement of the surface and the high point density of reflectControl, this noise can be reliably eliminated using special software algorithms. Therefore, the pure surface information remains."

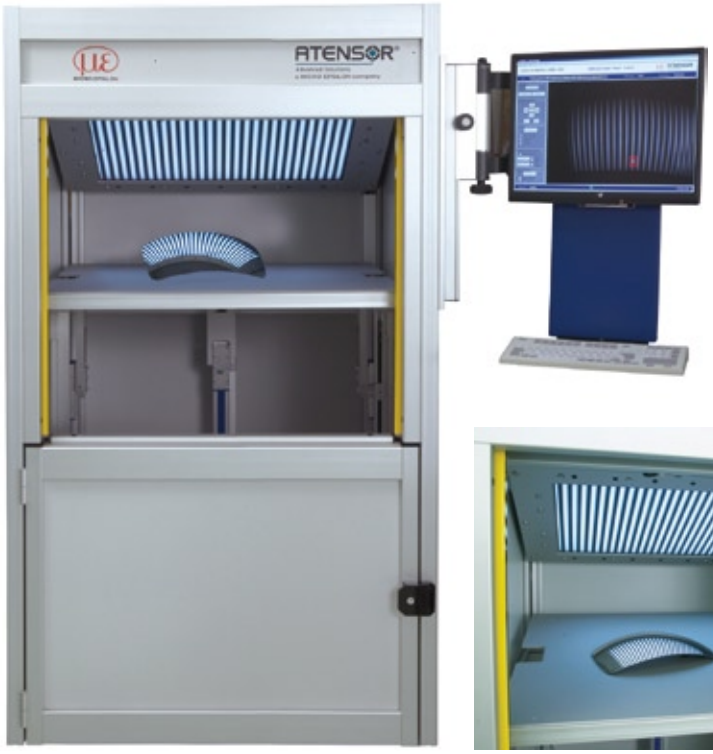
This is completely in contrast to alternative sensors that measure the curvature values in one dimension.

With reflectControl, the ratio of the measurement area to the resolution is superior to all other methods. Micrometer-sized defects are reliably detected and automatically evaluated by the integrated software algorithms. For subsequent processes, the data can be further displayed in simple forms such as defect reports; evaluation by a person is no longer necessary.

In addition to the RC-compact solution, Micro-Epsilon also provides alternative systems. The RC-Robotic system, for example, is intended to be utilized for very large objects such as complete automobile body shells. Here, the optical part of the measurement system is located on the end effector of a robot arm. A measurement process covers an area of approximately 70 x 30 cm; the robot moves the measurement system to different positions on the object to be inspected. For example, four RC-Robotic systems can be used in one cycle to inspect a complete vehicle body shell on a production line. Placed on both sides, these systems perform the complete inspection within 60–80 seconds. Afterwards, the detected defects can be marked up using special marking robots.

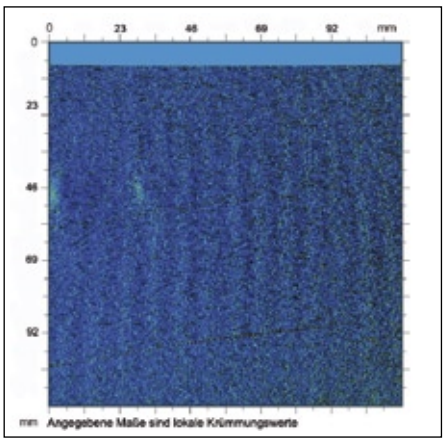
The manufacturer also provides RC-custom versions for specific measurement applications. The optimum system arrangement for the measuring object is developed, produced specifically for the customer and integrated for this appropriate variant in every environment.

If the exact speed of the strip, as well as the distance between the chatter marks, have to be measured, Micro-Epsilon also provides a non-contact speed sensor. The ASCOspeed 5500 was developed for use in foil and strip systems, as well as tube and profile lines in order to replace incremental sensors that are subject to slippage.

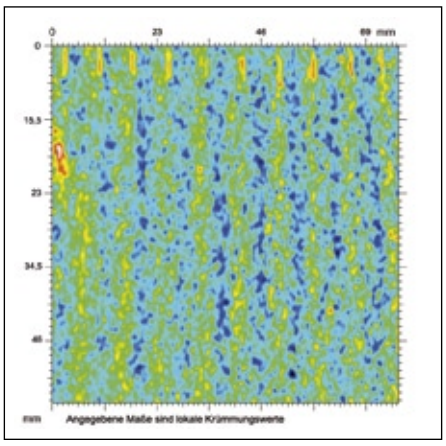


Changes in the surface curvature of the measurement object produce clear distortions of the stripe pattern

▲ The "RC-Compact" system for smaller measurement objects up to the size of a DIN A4 page



Result of a measurement with reflectControl. The light/dark transitions are the different surface curvatures



Recording of the surface curvature. The noise has already been reduced using filters. An undulation of the surface can already be seen.

often occur. Solutions can be devised in the shortest possible time and the electrical and mechanical engineering can be integrated on site.

With the reflectControl surface inspection system, the user is able to subject his products to completely objective and repeatable assessment. Errors in production are quickly detected after an inspection and can be corrected immediately. All reflecting surfaces such as polished and painted metal, smooth and painted plastics and galvanized surfaces, can be accurately measured. For borderline objects, anon site feasibility study at the customer's premises is normally required.

Solutions from the Sensor Specialists

The systems and equipment division of Micro-Epsilon develops, plans and produces turnkey measurement systems for process monitoring and quality control applications for many different industry sectors. This means that new technologies and systems are constantly being developed and integrated. The software is also programmed specifically for each system by the company's own software engineers. The company has special expertise in constructing special machinery, particularly in the development of new technologies. Everything from mechanical design through to software and custom sensor solutions is developed and produced in-house. This enables shorter, faster communication channels, resulting in faster response times. This is a huge benefit when it comes to the construction of special equipment and systems, where unexpected situations can

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Mass and Class

Even for small mass-produced parts, it is worth it to use industrial image-processing systems to guarantee first-class quality. At NP Plastics, small plastic rollers for document binders are checked 600 times per minute in three dimensions – with digital cameras from Allied Vision Technologies. To NP Plastics, an experienced Dutch manufacturer of injection-molded plastic parts, the perfect quality of the small white rollers was worth the investment in an image processing system. The challenge was to check the geometry of the approx. 5-mm-rings for defects and sharp edges (or burrs) at a rate of at least 600 parts per minute. To do so, the company turned to Radine BV. With the support of Data Vision, Allied Vision Technologies' sales partner in the Benelux, Radine developed a custom solution using digital cameras to optically check the rollers for quality.

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Flexible Track & Trace Concept

Seidenader Vision presents track & trace solutions for pharmaceutical packaging lines at Achema 2009 in Frankfurt. Seidenader Vision has developed a modular system for reliable product traceability. The track & trace solution is fully compliant with legislations regulating concepts like e.g. ITS (Turkey 2009), French Coding (France 2011) and e-pedigree (California 2015). Seidenader T&T Solutions is a combination of database management, coding systems, code reading technology and material handling systems, based on general standards. Due to experience in development, construction and installation from hundreds of inspection machines in the pharmaceutical industry, Seidenader's specialists combine automation know-how, vision system integration and mechanical handling engineering to provide turn-key track & trace concepts from one source.

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Quality Boosted and Zero Rejects

Mayer & Co., a global leader in its field has found the solution to their production problems in Cognex vision systems. While it's something we all do possibly several times a day - opening or tilting a balcony door or window, most of us are unaware of the technology behind it. Using cameras from Cognex and support from Buxbaum Automation, they were able to find the perfect solution to optimizing their production process. Rejects have been reduced to practically zero. Motivated by their success with the Cognex DVT 510 series, the engineers will be relying on Cognex quality for other production areas and lines in the future especially considering they were the first company in the industry to be certified to DIN ISO 9001 by the AGQS. The components are manufactured exclusively at the company's main plants in Salzburg and in Trieben.

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Nissan Works with Cognex Systems

At one of the most productive automotive manufacturing plants in Europe, accuracy and reliability at all points on the production line are of paramount importance. Nissan approached Capley Marker who was chosen to supply the system for a number of key reasons. They had previously installed five cameras at Nissan and converted a separate line to Cognex In-Sight cameras; Nissan were extremely satisfied with the level of support received through the existing relationship and finally, Capley is an approved Cognex PSI (Partner System Integrator). The system was to be supplied for use on the Nissan Micra and Note production lines. The key project requirement was to determine the glass type on the line, which could be one of four variants; Micra fixed side window right hand side (RHS) and left hand side (LHS); Note fixed side window RHS and LHS. A similar system is used on a second line which produces the Qashqai.

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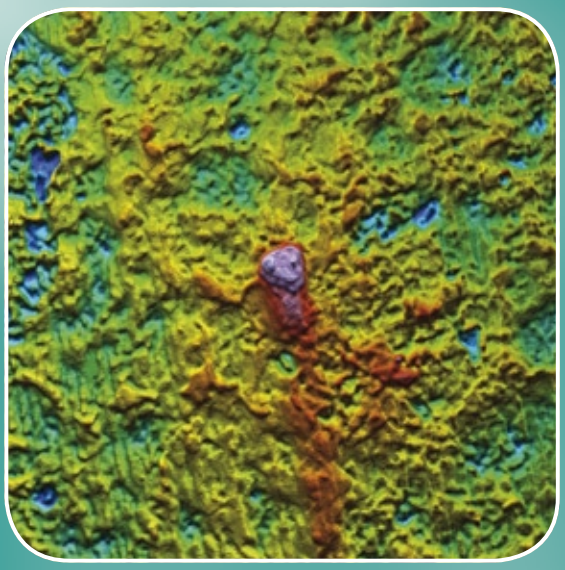
INSPECT

Control



CONTROL: MATERIAL INSPECTION AND MEASURING INSTRUMENTS

Optical measuring technology in industrial applications can be found in the Control section. Microscopy and image analysis for material inspection, the use of X-ray techniques for quality control in the field of foodstuffs, interferometry and photogrammetry for the recording of shapes in design and prototype construction are equally at home here as production monitoring with thermography, crash-analysis with high-speed cameras, optical coordinate measurement techniques or colour measurement technology and spectral analysis. From the wide field of measuring technology, two conditions must be met to make it into the INSPECT Control section: the components, products and systems are based on an optical principle, and the target group is industry.

Hot Freight

Automatic Ladle Condition Monitoring

Refractory materials are ceramic bricks that line the inside of the ladles to protect the metal ladle from molten steel at 1,500 °C

The transport of fluid steel has always been associated with considerable risks, even with the high safety standards of the steel industry nowadays. Even the specially developed protective refractory material cannot stand for very long the thermal stress to which it is exposed when in contact with the molten steel. A fully automatic safety system based on infrared imaging is capable of continuously monitoring the refractory lining of the ladles, so that eventual weak spots can be reliably detected long before they become critical. This system contributes so considerably to increasing safety in steel plants.

A failure in the refractory lining can lead to an uncontrollable spill of a large amount of liquid steel. Such a scenario endangers not only the workforce, but also represents a significant loss for the affected steel plant. How much damage such an accident can cause, was demonstrated a few years ago in a very unfortunate event.

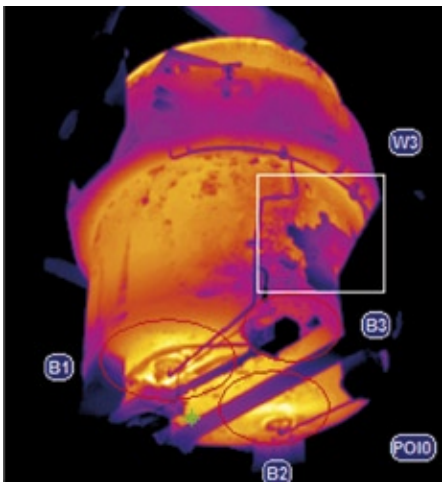
During a winter night in 2006, a steel plant in Duisburg, Germany was transporting molten steel from the oven to the converter in a 280 t capacity ladle, when the ceramic refractory material protecting the vessel from the liquid metal failed. The 1,500 °C molten metal "ate" its way out of the steel ladle in a matter of a few seconds, spilling red-hot liquid steel across the plant floor. Wiring, equipment, and the current production were instantly destroyed, resulting in months of downtime and more than €15 million in repairs.

In order to make sure they will not face the same fate, the operators of the ArcelorMittal's steel plant in Eisenhüttenstadt (Brandenburg), Germany, had a safety system installed for the continuous inspection of their ladles. Temperature measuring cameras monitor the temperature distribution on the complete surface of their ladles. The cameras are connected through a Gibabit-Ethernet network with a central computing unit, where a special software is running. This tool controls the whole system analyzing the images captured by the cameras. This way, critical material conditions can be detected full-automatically, long before the production has to be stopped due to safety reasons.

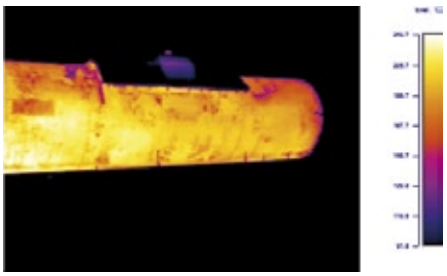
Good Reasons for Monitoring

In order to prepare the ladles for standing these extreme temperatures, they are lined with ceramic bricks. However, each time this refractory material gets in contact with the liquid metal, some of the material is burned away, thinning the refractory wall. Furthermore, ceramic bricks are very shock-sensitive, even though they are made of very robust material. So, it is just a matter of time for weak point to appear and develop into a safety problem.

"Our system is above all, a safety system that protects the workforce as well as the components and equipments of the plant," explains Michael Wandelt, one of the general managers of Automation Technology. "The system contains a database for storing the recorded temperature values. Through the analysis of this information we can do a more accurate estimation of the remaining lifespan of a ladle and enable the plant personnel to properly plan their maintenance activities in advance. Until now, the operation cycles of the ladles were determined by simple experience. Due to the high risk involved, the operation cycles were set rather conservatively, including an ade-



Temperature image of a ladle with evaluation areas



Torpedo cars carry large amounts of molten iron to the converting plant for final processing. Two infrared cameras monitor the condition of the refractory lining in the cars

quate safety margin. Here it must be remarked, that the renewal of the ceramic refractory material of a ladle can cost up to € 40.000. With the help of this infrared imaging monitoring system, operators can keep a ladle longer in operation without increasing the risk of an accident, and plan related maintenance activities in a more optimal way.

Camera Operation under Extreme Conditions

The liquid metal is transported from the oven to the steel mill through a railway using Torpedo cars. The inside of these cars is also lined with protective refractory material. Two infrared cameras mounted, one on each side of the railway, are responsible for the condition monitoring these torpedo cars.

The transport and metallurgic conditioning of the liquid steel inside of the steel mill takes place in ladles. A crane is used for the transport of these ladles, running a predefined path. Along this path, four maintenance free infrared cameras have been installed, which monitor the complete surface of the ladle. Each time the crane transports a loaded ladle, it passes through the field of view of the four cameras. Even though the cameras were installed several meters away from the passing ladles, they are still exposed to high ambient temperatures. That is one of the main reasons why they are mounted inside a special double-chamber enclosure. The field of view of the camera is also protected by a Germanium window, which is transparent in the infrared section of the electromagnetic spectrum. The inside of these camera housings is also cooled down by an air stream, so that the operation of the camera is not endangered by overheating.

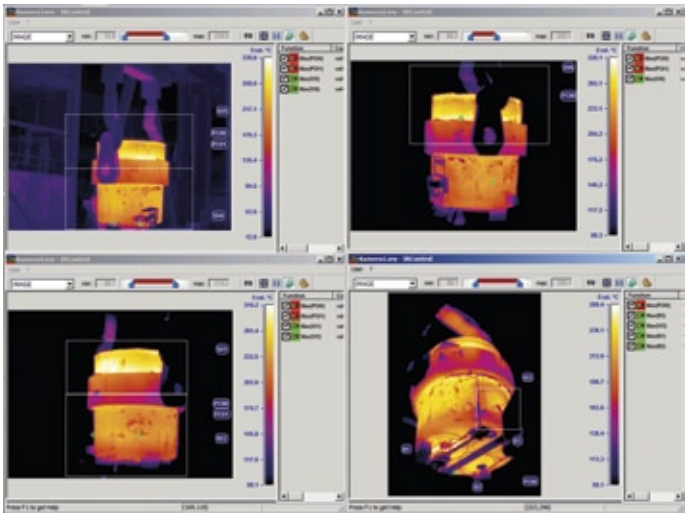
Each camera is connected to a Gigabit-Network for data transmission, and is able to work independently from the other cameras. The computer located in the control room is equipped with two Intel Pro/1000 MF Dual-Port-Server adapters, to grab and store the data received from the cameras via fiber-optics. This information is evaluated automatically in real time by the software IrMonitor, developed by Automation Technology. If a critical temperature is detected, IrMonitor will immediately send an alarm to the control center. The connection to the process-steering system is done very flexibly through different interfaces, among them OPC-Server, control and alarm signals through digital input/outputs, database connection through ODBC, Com/DCOM-Automation-Interface and RS232.

The fact that the system has been designed for working in harsh environments enables its flawless operation, even under the conditions present at a steel plant.

Intelligent Evaluation to Avoid False Alarms

The software running on the computer analyses each image sent by the cameras. Each time the crane transports a ladle in the field of view of a cameras, it is automatically detected by the software with the help of predefined object masks. The software can this way place an evaluation field exactly in the outline contour of the ladle, and move it together with the ladle during the measurement operation. Then, the software proceeds to analyze pixel by pixel all temperature values measured comparing them with the preset alarm threshold. All measured data from pixels outside of the evaluation field are not considered during this analysis. High temperature values captured in the image from, for example a burner, or from an oven, also in the field of view of the camera, can be discarded this way. This method minimizes the danger of false alarms, which is particularly important in steel plants having several equipments presenting high temperatures. Another advantage of this method is that the crane operator does not need to neither stop the ladle nor pass it always using the same path for the system to check its temperature.

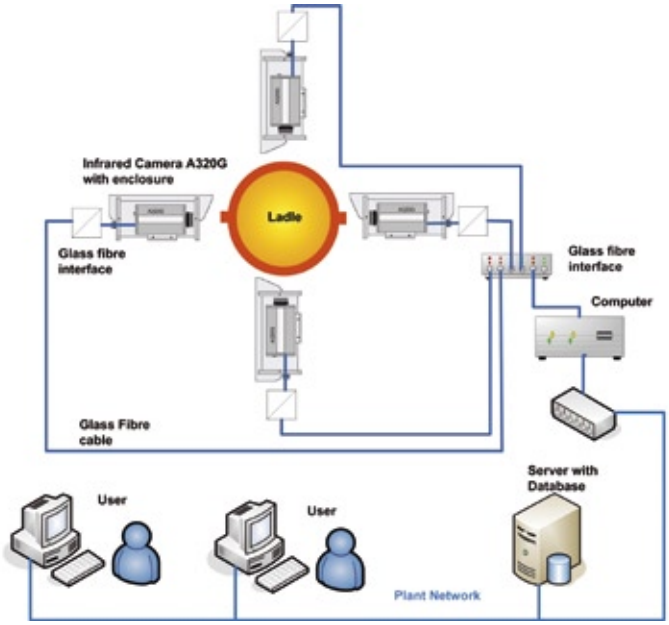
Michael Wandelt summarizes the inspection process as follows: “Taking into consideration the previous experiences from the steel mill, we can say that the safety of the plant can be guaranteed as long as the outside temperature of the ladle does not exceed 400 °C. As soon as the system detects a temperature above this limit, it will send an alarm to the control center. At the same time, the infrared image with the critical area of the ladle is displayed in the control room including its identification number. Through this identification number, the system can also display a graphic of all temperature values measured so far for that unit. This information can be really helpful for the decision makers when deciding the following steps to be taken.”



The specially designed multi-camera software IrMonitor evaluates the temperature images and controls the whole system

Additionally, the system performs an automatic trend analysis of all temperature measurements carried out on the current ladle. This enables a reliable detection of a sudden rise in the temperature, which is always the first indication of a weakening of the protective refractory material.

In order to guarantee the reliability and failure-free operation of the system, several self-test functions have been implemented. For example, every infrared camera has in its field of view a heat emitter whose temperature is exactly 70 °C. This emitter delivers for each temperature measurement a reference value, so that any possible related failures can be immediately detected and the control center can be informed.



Setup of the system for condition monitoring of the ladles

Conclusion

The condition monitoring of torpedo cars and ladles with an infrared imaging system enable steel plants to improve their safety standards considerably. At the same time, such a system makes it possible to accurately determine the remaining lifespan of the protective refractory material of ladles and torpedo cars. These equipments can so remain in operation for a longer time without increasing the risk of an accident; and maintenance activities can be planned in advance reliably. The system is as far as possible maintenance free, and possesses several interfaces and self tests functions.

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Control 2009 – Opening Up New Dimensions

The "new" Control 2009 will offer added value where information, communication and business are concerned by allowing participants to look beyond their current horizons and presenting issues which complement the QA process sequence such as vision systems, image processing and micro-metrology.

Control has evolved into an internationally recognized trade fair with its core topic of "quality assurance". In order to secure its role as an industry trailblazer in the future as well, all factors, technologies, products, systems and services covering all aspects of industrial quality assurance in all relevant fields of endeavor will be adapted to current levels of technological progress.

A Glance at the Essentials…

Beyond this, the "new" Control 2009 will open up further horizons for all complimentary and service topics pertaining to the process sequence. By taking related topics such as vision systems and image processing into consideration to an even greater extent beginning in 2009, and by providing more space than ever before for microsystems technology (measuring technology for miniature and micro-components) and industrial weighing and counting technology, as well as rapidly developing sensor technology, the event will offer exhibitors even more opportunities and additional benefits, and genuine added value for the expert visitors.

Quality assurance will of course also be the main theme of the 23rd Control, but the event will also cover influencing factors which effect all sorts of concerns, for example in production and assembly, in the spirit of the process sequence philosophy. Hardware and software are undergoing change. Trend topics including energy efficiency, lightweight construction, conservation of resources, recycling, microsystems technology, bionics and nanotechnology are long since a lot more than just trendy, they've become essential for research and the development of new products and manufacturing technologies.

The changes which go hand-in-hand with this situation necessitate a new, or at least an expanded way of looking at things – especially in consideration of the fact that QA strategies and quality assurance equipment not only have to be adapted to current and future general conditions, they also need to be adapted to prevailing economic necessities in a highly flexible fashion, especially in economically difficult times. Again and again, technological development in the fields of 3D measuring technology, vision systems, image processing, sensor technology and micro-technology result in genuine "automation advances", which in turn generate increased productivity and improved quality.

The 23rd Control, which will take place at the Stuttgart Exhibition Centre from 5 through 8 May 2009, will focus on its core topic of quality assurance, will venture an intensive glance at future topics related to current actual practice, will provide a realistic preview of all possible side issues, and will take a closer look at solutions for domestic and global markets on behalf of the users – the "new" Control 2009 is thus more than just quality assurance.

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Laser Tracker for Aircraft Construction

Plant Construction and Steel Building

This is a future airplane? Hard to believe, because even the heavy 2.5 t simulation weight – representing the later aircraft fuselage – makes it hard to understand, that this stands for a production site of an Airbus body. But, if you imagine the enormous complexity to produce with the highest possible accuracy and precision, even the latest production site of the automotive industry are incommensurable. The quality requirements of Airbus represent the highest standards of measurement and production technology of MCE Industrietechnik Linz GmbH & Co (Austria).

Tomorrow is the day of the final acceptance test; today's last measurement series is related to the sliding carriage; its repeat accuracy – proved by 50 test runs – should be better than 15 hundredth. "This data have to be sent to Hamburg this very day." August Katteneder argues, technician in measurement technology at MCE Industrietechnik Linz. "Without the results the test engineer at Airbus in Hamburg even doesn't hop on the plane."

The assembly mount has been assembled by HTK Maschinen- und Apparatebau GmbH in Königswiesen/Linz (Austria). In the company's assembly hall the finally acceptance test will take place. The production line of the Airbus has been built up here, and after the acceptance procedure, the last of six assembly mounts will be sent to Airbus on a three-days-trip by a low-loading truck. Installation will take place on a 55 m rail system, as well built by MCE steel and machine building. The height tolerance of the rail system is restricted to 5/100 mm regarding the full length of the rail. The evidence is also provided by a laser tracker.

These high demands on the accuracy required a change in the measurement equipment pool at MCE. "Up to now we pin our hopes on tachymeter and theodolites," Mr. Katteneder argues. "But the Airbus people asked for the third decimal place – impossible to achieve with conventional measurement equipment. The Laser Tracker is the one and only mobile 3D-measuring system delivering results with the required accuracy. And because the reflector-based measure concept of Airbus, we are using the Laser Tracker for all work regarding the assembly mounts."

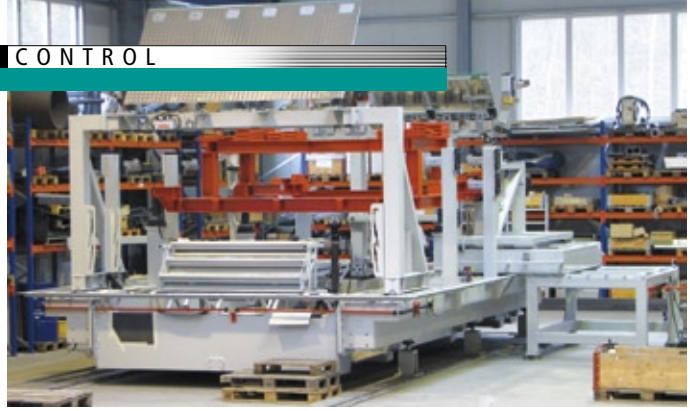
The API Laser Tracker has to be mounted at a special location within the construction. The construction has been built up in that way, that all measuring points – reference points and measuring adapter – can be reached by a single line-up. Even block-outs and holes within the simulation weight have been symmetrically arranged, to achieve the highest realistic operation conditions. "For this application we manufactured more than 30 high-precision measuring adapter made of nickel silver with a length accuracy of 1/100 mm. These adapters are used in production for holding the stints of the fuselage. The measuring adapters allow referencing in combination of the coordinate system of the airplane. Measuring is done with 0.5″ respectively 1.5″ measuring spheres."

Regarding the selection process of the measurement system the portability of the system in addition to the required accuracy has been the main argument.

"All other systems available on the market are significantly heavier and larger than API's Laser Tracker," August Katteneder argues. "Traveling a lot, we need the full mobility of the system. Aside from the efforts regarding traveling by plane, we can not afford to abandon a Laser Tracker as cargo only because of weight reasons. And there is too much risk that the system is blocked for a while by the customs at the place of destination. Having no measurement system in place means unneeded idle times." The excellent order situation at Airbus results in a significant increase of capacity at MCE.

But aerospace industries are only a small part in comparison to all the other industries with comparable high demands for quality in production: As a producer independent service provider MCE is delivering services for industrial plants, buildings and infrastructure facilities all over the world. Traveling by car or plane to building sites at home and abroad the Laser Tracker is carried mostly in the cars trunk. Currently the Tracker is used in Egypt in a project regarding a heat exchanger built in Linz. After the on-trial assembly at the MCE plant construction the heat exchanger is finally assembled on-site.

To meet the challenges: Even in the Guinness Book of Records you will recently find MCE. In Pakistan MCE installed the largest penstock of the world (13 m diameter).



Assembly mount for the Airbus – exterior and interior. In red: Simulation weight for the later fuselage.

The Laser Tracker (middle of the picture) is used for measurement, justification and und positioning of the mount.

Special holes within the construction, which simulates the weight of the fuselage, enables measuring the lightweight construction taking realistic production preconditions as a basis.

Measuring a reference point at the assembly mount done by technician in measurement technology August Katteneder.

The measurement equipment could be stowed away in a small case.

All other laser trackers available on the market are significantly heavier and larger than API's system.

About Automated Precision Inc.

Automated Precision Inc. develops, produces and drives world-wide metrology products such as Lasers Trackers and Laser Interferometers, which rank among the most efficient systems of their class. Founded by Dr. Kam Lau in 1987, API has pioneered progressively higher standards of accuracy for coordinate measuring and machine tool operation. Over its two-decade history, API's products have been installed and used by all of the world's leading automotive, aerospace, machine tool, and CMM manufacturers. API's headquarters is based in Rockville, Maryland, USA with offices located throughout North America, South America, Europe, Mexico, India and Asia. Further information about API is available at www.apisensor.com

The world is not enough: The mobile measurement system also proves itself in the context of free navigatable systems (unmanned fork lifts). Based on the layout of the hall several magnets have been mounted to the halls floor to determine the routing of the fork lifts. The unmanned vehicle uses magnetic fields for navigation. The exact positions of the magnets have been measured with a very high precision using a Laser Tracker.

For MCE it is good to know, having the capabilities and the know-how to satisfactorily show that mandatory accuracies and tolerances could be followed in every step of the production process – it have been the high quality products and services, which turns MCE into a worldwide accepted Life-Cycle-Partner of many industries.

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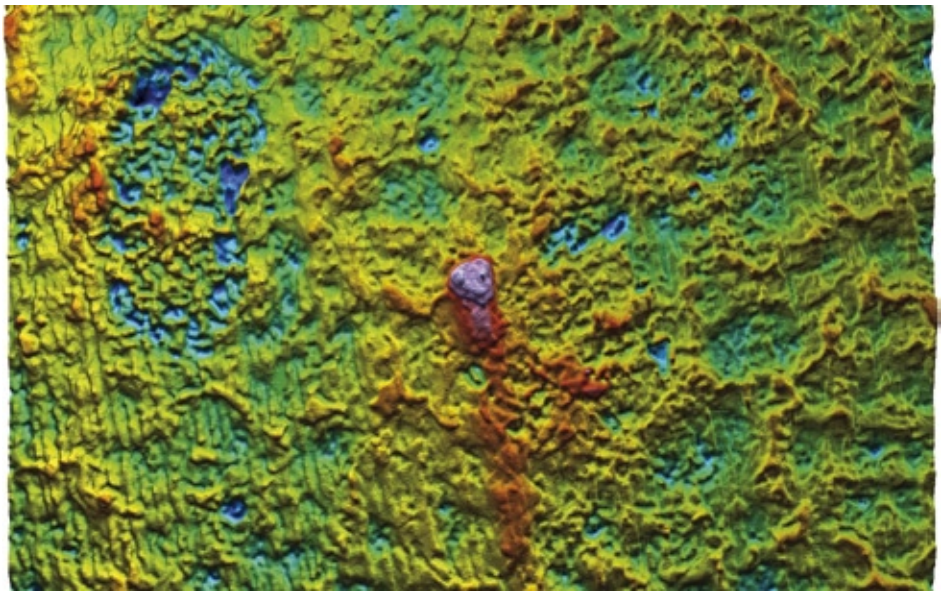
Investigating the Material World

New Capabilities in the Study of Corrosion

Corrosion is a big problem. From metal and concrete to polymers and electronics, different forms of decay lead to structural and functional failures that can sometimes be of fundamental importance. The Swedish Corrosion and Metals Institute – Swerea KIMAB, is focused on developing and improving solutions for materials research. As such, they are studying corrosion in its many forms as well as the various methods used to prevent it.



Martin Jönsson works at Swerea KIMAB with corrosion questions. Lext Confocal microscopy has been a key instrument in his research around the influence micro-structure on the corrosion behavior of magnesium alloys.

From the Deepest Depths to the Highest Heights

Many people just see corrosion as a more scientific way of defining "rust", but in actual fact most materials will undergo some sort of surface or sub-structure changes throughout their life. We don't worry about these changes for many materials we use, as their failure does not have serious implications within their useful lifespan. But corrosion is a major consideration in the construction of critical infrastructure elements such as: buildings; transport; communications; oil, gas and water pipelines; as well as medicine. Therefore understanding corrosive processes and how best to avoid or prevent them is of paramount importance from the deepest depths of the oceans to the highest heights of space. However, different materials corrode differently, which makes it impossible to establish a common process or to produce a universal way of preventing it. One key corrosive process commonly affecting metals is known as Galvanic corrosion.

Galvanic Corrosion

Galvanic corrosion is an electrochemical process where one metal corrodes preferentially when in electrical contact with a more 'noble' metal, if there is an electrolyte joining the two. A noble metal is one that has a lesser tendency to oxidise, or lose electrons. Gold and platinum are examples of very noble metals and therefore hardly ever corrode. On the other hand there are a large number of un-noble metals, which give away electrons very easily, e.g. magnesium and zinc.

Galvanic corrosion commonly occurs, for example, where two metals are used together for their different properties – i.e. a steel washer might be used to distribute load around a fixing through magnesium or zinc for example. Iron nails were sometimes used to attach copper cladding to wooden battleships and the Statue of Liberty uses copper sheeting for "shape" and wrought iron for "strength". In all these situations, rain, condensation or seawater may connect the two different metals and act as the electrolyte, providing a means for ion migration.

Studying Corrosion

Swerea KIMAB, in Stockholm, Sweden, researches metals and corrosion, from both government and commercial sector funding. Within this Institute Dr. Martin Jönsson has a key role in the research of metal corrosion.

As well as using standard laboratory tests to recreate corrosive atmospheres, such as increased humidity, high temperatures etc, Jönsson's team uses another, rather unusual, method. He commented, "Lorries and coaches cover many thousands of miles across Scandinavia every year and experience harsh environments. These make them very useful and highly effective test beds!" He continued, "We attach test plates made from varying grades of metal or coated in different ways (depending on the experiment) to the underside of the vehicles and then collect them again after a set period of time."

Of specific interest to the Group is the corrosion of magnesium. The low density

and high specific strength of magnesium alloys have created a great deal of interest in their use in the automotive and aerospace industries, as well as in portable electronics. For all of these industries, weight is an extremely important consideration.

However a big problem with the use of magnesium is that it is a very un-noble metal and therefore corrodes very easily. In fact, magnesium is so "corrosion-active" that it is often used as the sacrificial anode for structures such as ships and buried pipelines. Magnesium is very rarely used as a pure metal, instead it is alloyed with a range of different metals depending on the desired properties. However, in the same galvanic process as described above, mixing un-noble and noble metals in an alloy can create corrosion problems on a micro-level – i.e. the galvanic cell is established between the different metal grains of the magnesium alloy and therefore no other metal component needs to be present for corrosion of the less noble areas to occur preferentially.

Instrumental

Whatever the source of corrosion – natural or manmade – assessing the impact requires a range of instruments. To improve the corrosion properties of materials it's essential to get a grasp of the theory and a deeper understanding of the corrosion: Why and how does a specific material corrode? What can be done to improve its ability to withstand corrosive environments? To achieve this, it is essential to get a microscopic view of the metal surface and to then be able to measure various aspects of it. A confocal laser scanning microscope (cLSM) – the Olympus LEXT OLS3100 – is used along with a scanning electron microscope (SEM) to provide a plethora of data for analysis. SEMs enable researchers to get a extremely close up view of the subject and are also used at Swerea KIMAB to provide compositional analysis of the various grains present in magnesium alloys, for example. Confocal laser scanning microscopy on the other hand, provides exquisite surface detail and highly precise metrological analysis of the surface. This is achieved since it has a broad magnification range (20x – 14,400x) and a maximum resolution beyond that of standard optical microscopes (120 nm in the XY plane and 10 nm in the Z plane). This is combined with powerful mathematical measurement algorithms providing 1D, 2D and 3D measurements of any surface feature – e.g. the width and depth, area and volume of a corrosion pit.

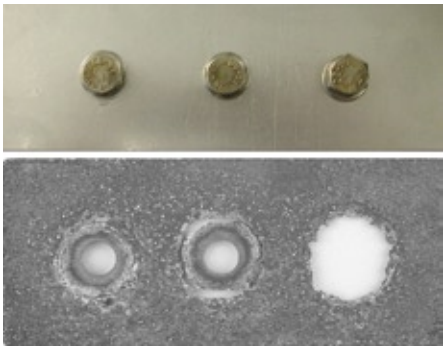


Fig. 1: Corrosion test panels: At the top an unexposed magnesium panel with steel fasteners. At the bottom a panel that has been exposed under airport coaches for a year. The corrosion is severe

Results in Brief

When this cLSM analysis is combined with SEM data, a whole new level of results can be generated. In figure 2, for example, a grain from an AZ91D magnesium alloy can be seen. With cLSM a topographic image is generated and the corrosion attack can be viewed and analysed on a micro level. By comparing the same area in the SEM it is possible to get the composition of the different elements that form the grains of the alloy. By combining the results from the two techniques, a corrosion attack within the microstructure of the alloy can be connected with the different alloying elements. These results can later be used to manufacture more corrosion resistant alloys.

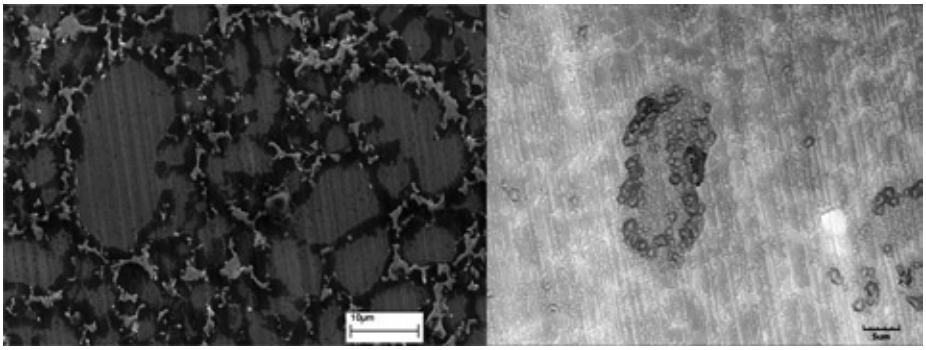
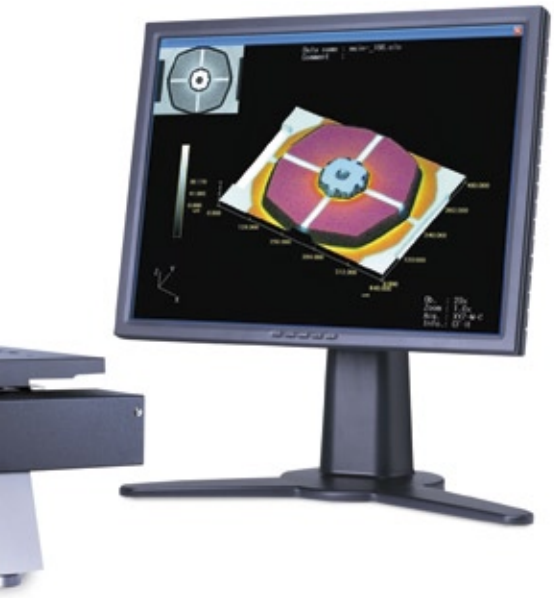


Fig. 2: The two images, taken using different techniques, show the same grain in an AZ91D magnesium alloy. To the left: An SEM image provides analysis of the different elements. To the right: A confocal image shows where in the microstructure the corrosion attacks have started. (Note the high magnification)

As a result of recent studies using cLSM in combination with SEM, Dr. Jönsson has shown that the aluminium content in the different phases of the magnesium alloy has a strong influence on the overall extent of corrosion. For example, phases low in aluminium suffer greater corrosion, whereas those high in aluminium display less corrosion. As a result, alloys such as AM50 that are low in aluminium will corrode faster than those with a higher content e.g. AZ91D. This doesn't mean though, that AZ91D doesn't corrode, it is just slower to do so! [1, 2]

Investment Dividend

Confocal laser scanning microscopy has made an important impact on Dr. Jönsson's work and is now also being used in other research projects at Swerea KIMAB – one of the world's leading metals and corrosion research institutes. This is due to the fact that cLSM instruments are very versatile, providing advanced surface profiling including roughness analysis, as well as precise linear and area/volume measurements. Dr. Jönsson



The Olympus Lext OLS3100 confocal laser scanning microscope

commented, "I can place samples directly on the stage without any pre-treatment or destruction of the sample and the actual analysis doesn't alter the surface of the sample. cLSM is therefore an excellent addition to our other techniques and also offers unique documentation and measurement properties itself, as a stand-alone tool", commented Jönsson.

He continued, "The images produced using cLSM, enable me to better understand what is actually happening at the level of the grains and boundaries, even without looking at the measurement data."

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[2] Jönsson M. *et al.*: J. Electrochem. Soc, 154 (11), C684–C691 (2007)

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Nikon and JEOL Join Forces

Nikon Instruments Europe and JEOL have announced an agreement that appoints Nikon as the official European distributor of the innovative NeoScope benchtop SEM (scanning electron microscope). Whether used by trained electron microscopists as a compact screening instrument, or by lab technicians seeking a higher resolution alternative to the light microscope, the NeoScope will help accelerate the pace of research in all fields. Offering simplicity and affordability along with benchtop convenience, the NeoScope is ideal for use in the areas of sampling inspection, failure analysis of manufacturing materials, materials research, metallurgical laboratories, medical devices, forensics, bioscience research, pathology and environmental laboratories.

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Laser Micrometer Offers Twice the Measuring Range

Laser micrometers are now available from Micro-Epsilon that provide more than double the existing measuring range. The two new models are called optoControl 1202-75 and optoControl 1202-100. The measuring range of these two new devices is 75 mm and 100 mm respectively. The sensors are therefore ideally suited to applications where previously two laser micrometers had to be used, since the measuring range of one sensor was insufficient. An additional controller unit is not required for the two new models. Nevertheless, the transmitter and receiver unit has a height of just 30 mm. For both measuring instruments, the transmitter is separate from the receiver; therefore, the measuring instrument is extremely flexible for mounting. The measuring device is fully digital with a CCD array as the receiver.

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Mobile surface analysis and documentation system

The new, patented Traceit system is the only instrument on the market that analyses, documents and evaluates the topography as well as the visual appearance and thus the visual impression to the human eye of exactly the same area reproducibly. Of the data the system calculates key numbers. Furthermore, it is possible to determine e.g. effective contact area, particle or porosity distribution by height cuts through the topography.

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Interference Filters

Edmund Optics introduces narrow laser line interference filters and broadband diode interference filters. The interference filters feature a bandwidth of just 1 nm – the narrowest bandwidth available in the industry. The filters are an excellent choice for systems that require an extremely narrow bandpass. They are typically used to enhance the signal-to-noise ratio of laser-based analytical instrumentation. Primarily utilized with gas and DPSS lasers, narrow band (1 nm) filters are used in the sensor path to eliminate all ambient light (noise) and allow the sensor to detect the laser wavelength. Using a narrowband interference filter, a system may not require dispersion elements such as prisms or gratings, allowing a lower cost than other alternatives. The filters provide transmissions of greater than 50% and OD greater than four from 200–1,150 nm wavelength.

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Visiona

Interview with Keith Attwood, CEO e2v

INSPECT: Mr. Attwood, the history of e2v goes back to 1947 when Phoenix Dynamo the predecessor of English Electric Valve (presumably the first name giver of e2v today) was founded. In which technical area are the roots of e2v?

K. Attwood: The roots of the company go back to 1929 in the development of vacuum valves for Marconi in Chelmsford. During the early 1940's we developed radio frequency sources (magnetrons) for air and land defences.

How and when did the company change to a leading provider of imaging sensors and cameras?

K. Attwood: In 1947 we produced Vidicons, television camera pick up tubes, which over time were replaced by Orthicons in the early 1950's in the delivery of global TV broadcasts.

e2v's first CCD imaging sensor was developed in the UK in 1972 with the first French sensor following in 1978. They were initially designed to address space and military markets, with the company later moving into medical, scientific and industrial markets. We have always focused on niche markets, where our technology can offer real added value to our customers.

You were appointed Managing Director of e2v in 1998. What has been the biggest success for you in the field of imaging since then?

K. Attwood: We have had many successes and continue to see our imaging sensors feature in major space projects all over the world. Highlights include the upgrade of the Hubble Space Telescope, Spot 2-Spot 5 satellites, the instrumentation onboard Gaia, NASA's STEREO and Solar-B missions to study the Sun and the Mars Express mission.

Another key success was receiving The Queen's Award for Enterprise in 2006 in recognition of our outstanding achievement in innovation for our L3 technology; CCD sensors which enable enhanced imaging across all light levels and spectrums.

e2v is also a world leader in Digital Dental X-ray Imaging, involved in business relationships with the biggest OEM medical equipment manufacturers. Dental X-ray sensors make use of the wide range of technologies and skills present in the group, from advanced packaging to high end electronics integration.

In the field of industrial imaging we have developed world class high performance image sensors in both CCD and CMOS technologies, some of which are used in our own e2v branded industrial cameras which represents a significant competitive advantage. The range of products covers a wide application spectrum from high resolution/high speed arrays to innovative multi-line linear sensors.

The key to all these successes has been the development of long term relationships with our customers; these have enabled us to develop highly competitive solutions with them.

What is the product range of e2v today and which industries or applications are served?

K. Attwood: Well, e2v has four major product groups:

Advanced imaging sensors and cameras for applications including industrial process control, dental X-ray systems, space science and life sciences. For each of these niches, e2v is number one in Europe and in the top two or three worldwide. Among the most famous product (family) stand our OEM dental sensors, our industrial line scan (e.g. AviivA and EliixA) and the L3 sensor and camera family.

The second group is high power RF electron devices and subsystems; for applications including defence electronic countermeasures, radiotherapy cancer treatment and radar systems.

In the third major product group specialist semiconductors are found, including logic, memory and microprocessors for high reliability, mission-critical programs in avionics, defence and telecommunications, sensor data acquisition, and high speed data conversion.

A range of professional sensing products for applications including fire, rescue and security thermal imaging, X-ray spectroscopy, and military surveillance, targeting and guidance completes our range of products.

What is your personal vision for the development of imaging technology within the next 10 years?

K. Attwood: Imaging is a huge market with strong growth potential, thanks to a wide variety of applications. For example, we are now seeing machine vision imaging devices being applied to non industrial applications such as biotech and security.

e2v primarily focuses on professional markets, and we believe that CCD and CMOS technologies will co-exist as each has its advantages and also its limitations. CCD image sensors remain very relevant for low volume applications, whilst CMOS is promising because of its capacity for integration (including embedded processing). It therefore provides a very attractive price/performance ratio at system level, allowing entry-level professional markets to be addressed which have previously been inaccessible for price or consumption reasons.

At e2v, we are proud to be able to fully control the production process from conception, right up to the final manufacturing of our sensors and cameras. We continually invest in our front-end capability (e.g. with development of our back-thinning process) ensuring we are able to meet our customers current and future requirements.

Mr. Attwood, thank you very much for this interesting talk.

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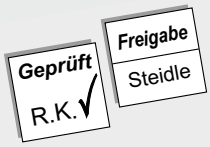

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