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POINT GREY
Innovation in Imaging

A Plea for Software-Benchmarks

It was in late 2007 when I was met with harsh criticism in the industry. In the course of a panel discussion about vision software I had made the proposal to work on making the performance of vision software comparable for the end user. Along the lines of standard EMVA 1288 for cameras (see page 6) a binding definition of performance criteria and an accurate description of benchmark scenarios could be employed to compare the different software solutions for the different vision tasks. The resulting data could help users in their decision for suitable tools and products for their application.

This proposal was not very well received by some of the software suppliers back then. There was talk of the difficulty to come up with a distinct specification and of the necessity to distinguish oneself from competition especially by the differences in the software and the resulting impossibility to provide a direct comparability.

However, a couple of days ago Dr. Wolfgang Eckstein from MVTec delivered a public and concrete proposal on how such a benchmark could be designed and executed. He, as well, suggests to define performance criteria for typical vision applications like barcode identification or pattern matching, to establish a uniform fixed framework for the benchmark, and then to execute the comparison on selected, standardized and well-described image data.

There is a very similar approach already established in other industries, BTW. The British Home Office Security Development Branch (HOSDB), e.g., provides libraries (i-LIDS) with video footage to companies from the video analytics area for a benchmark of their software in applications like people tracking covering several cameras, perimeter surveillance or detection of abandoned luggage. This gives the suppliers the opportunity to test the capabilities of their products in a well-defined scenario and based on relevant input data while the potential customer has the chance to compare the performance of the different software packages.

The challenge, here and there, is of course in the sensible choice of application relevant image data and this gets even more demanding the more complex the vision tasks becomes. May it be even relatively straightforward to decide upon images and testing scenarios for the determination of a barcode identification performance, it ventures into the indefinite complex to do this for a surface inspection.

But there is yet another aspect, not taken care of with a pure performance benchmark of algorithms, for the value rating by the user, however, at the same level of importance: the usability of the software. How laborious is the parameter set-up of the tool, how transparent is the result extraction, and how coherent are system and result messages and reports? The answer to these questions can determine the success or failure of the application, independent from the performance of the algorithms employed (see page 22). While following the goal to accomplish transparency and to provide impartial decision criteria to the user, this latter aspect of vision software performance needs to be included in any benchmark.

All aspects considered a benchmark of vision software is by no means a small feat, but definitely one that is worth the effort. One can only hope that Dr. Eckstein´s advance will be taken on by other players in the industry. The real benefit will be achieved only when the definition of the performance criteria and the description of the benchmark scenarios as well as the design of the image data basis are derived from the input, the know-how and the experience of many experts and the procedure and the results will then be supported by many of the suppliers.

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Beyond the Noise ▶ 6

Custom-made Off-the-Shelf ▶ 22

In the Mold ▶ 34

In the Pole Position ▶ 42

NEWS

003 Editorial
Gabriele Jansen

004 Imprint

006 Beyond the Noise
Putting Camera Standard EMVA 1288 to Use
Mathias Dotzel

009 International GenICam Meeting in Munich

COVERSTORY

010 Retrofit Design Dragon Style
Easy Conversion to Modern LED Line Lights
Michael Schneider

012 Online Portal for Machine Vision and Optical Metrology
Relaunch in June 2009 Offers New Valuable Features
Markus Caspari

014 News

016 Scanning Objects Fast and Wide
3D Laser Scanners Register Areas in Wide Range

IMPRINT

Published by
GIT VERLAG GmbH & Co. KG
Rößlerstr. 90
64293 Darmstadt, Germany
Tel.: +49/6151/8090-0
Fax: +49/6151/8090-144
info@gitverlag.com
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Account No. 0171550100
Routing No. 50880050

Advertising price list from October 2st 2008

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Printed in Germany
ISSN 1616-5284

CONTENTS

NEWS

017 **25th Anniversary of Fanuc Vision**
Long-term Strategy Pays Off

018 **Clean Slate**
Image Processing Basics: The Background
Prof. Dr. Christoph Heckenkamp

050 **Visionaries**
Interview with Dr. Jürgen Geffe,
Managing Director of Vision & Control

051 **Index**

VISION

022 **Custom-made Off-the-Shelf**
User Interface of Machine Vision Software in Automated Inspection
Christian Demant

026 **Well-lit**
Correct Lighting Increases Reliable Detection in Industrial Automation

028 **Minority Report**
Futuristic Interface Technologies by 3D Vision
Martin Profittlich

030 **Products**

AUTOMATION

034 **In the Mold**
3D Quality Inspection of Cast Parts
Ricardo Rodrigo

036 **High-Tech for Farm Equipment**
Yield Increase and Quality Improvement in Robot Welding by Usage of Laser Vision Systems
Jean-Paul Boillot, Jeffrey Noruk

039 **Products**

CONTROL

042 **In the Pole Position**
Optical Measuring System Determines Geometry of a Differential Gear Casing
Falko Puschitz, Prof. Dr. Friedrich Bleicher

044 **Continuing on the Road to Success**
Control 2009 – First Impressions and New Products

048 **Products**

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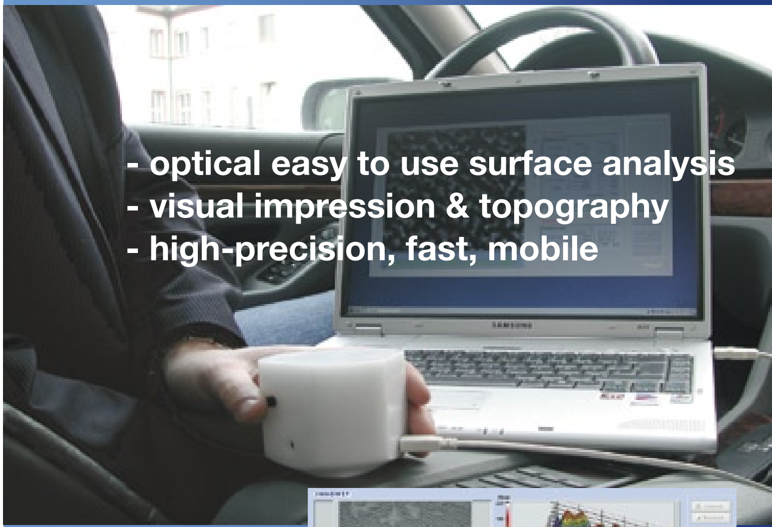

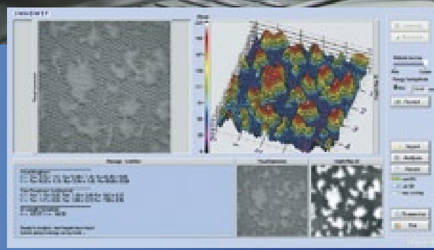

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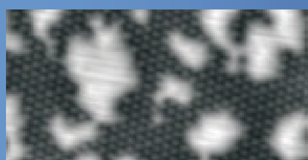
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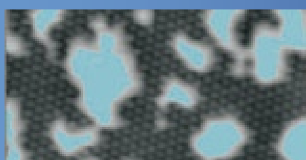
visual impression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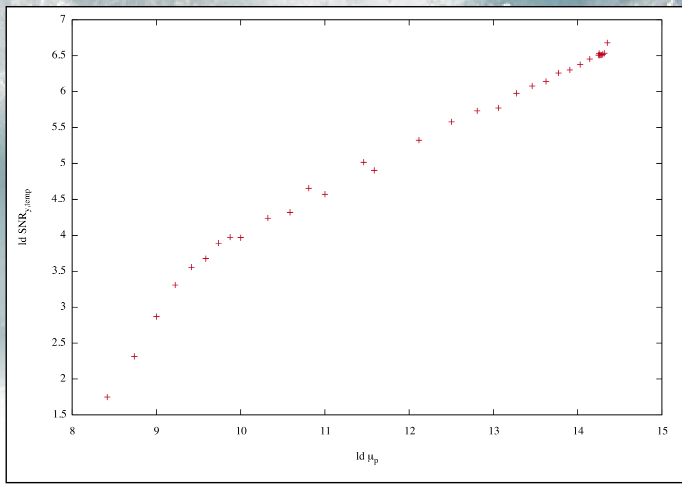
Beyond the Noise

Putting Camera Standard EMVA 1288 to Use

Pepperl+Fuchs is a worldwide operating manufacturer of sensors and components for process and automation technology. Their portfolio encloses, among others, camera-based systems such as vision sensors and optical identification systems, which are being developed at daughter company Omnitron located in Griesheim, Germany. At Omnitron, within the framework of a diploma thesis, a procedure was introduced for the qualification of the camera sensitivity taking into account the influence of noise. Embedded in this procedure is the camera standard EMVA 1288.



Signal-to-noise ratio as an independent measure for the sensitivity

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EMVA 1288, hosted by the European Machine Vision Association, was originally developed to enable the users of industrial and scientific cameras to compare the technical data of the camera data sheets provided by the camera vendors. The standard provides a defined test frame as well as the defined presentation of the resulting data. Within this standard, one method is the "photon transfer method" (PTM). The work for the diploma thesis employed the EMVA 1288 standard to ensure a later comparability of the results.

The Formation of Noise

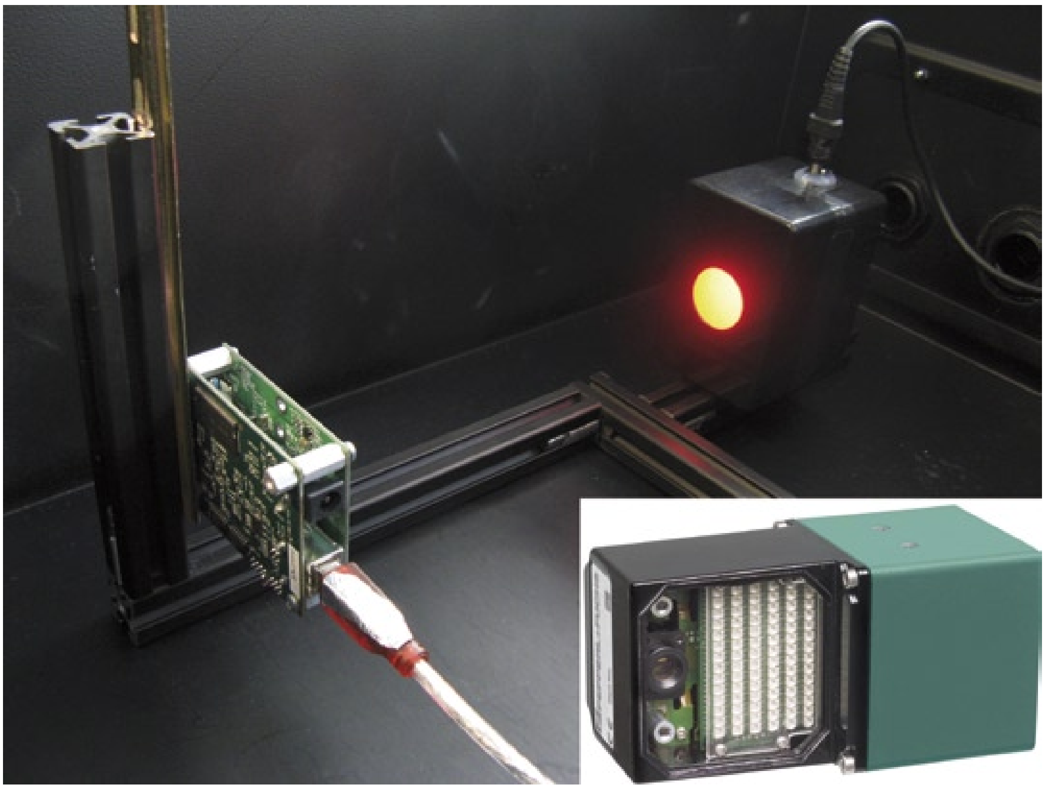
As an introduction to the standard, this section will briefly explain the functionality of a camera. Light, in the form of photons, shines on the image sensor. The photon transfer creates an electrical charge in the image sensor. With the help of a capacitor, this charge is converted into a voltage, which is amplified before an ADC digitizes it. The digitized steps can be shown as grey values in digital images.

In this process a noise will develop that adds to the signal. This noise is sub-divided in three main types: a temporal noise, a spatial noise and quantization noise.

As to the temporal noise, the digital signal of an individual pixel varies from frame to frame. Reasons for the spatial noise are due to the production process of the image sensor. In an image one can recognize it as a fixed pattern. It also exists when every pixel is exposed to precisely the same amount of light and the temporal noise is removed. Particularly CMOS image sensors suffer strongly from spatial noise. Quantization noise stems from converting the amplified voltage into a digital signal with discreet steps: The coarser these steps are the bigger is this specific noise.

Standardized Measurement Set-ups

The standard EMVA 1288 describes a complete set-up for the experiment and the measuring requirements. First, it is important to shield the



Set-up in the dark room an the qualified code reader MAC 400 (small image) camera against any ambient light and to work with a defined monochrome illumination. The wavelength can be chosen arbitrarily. Moreover, the image sensor should be illuminated very homogeneously. This is accomplished best by a set-up without an optical lens and by making use of a Lambert's emitter. The standard's description of the geometrical configuration is comprehensive and very easy to understand. The diameter of the emitter in combination with the distance to the camera should result in an f-number of 8. The set-up used in our experiment is shown on page 6.

The light source is an approximate Lambert's emitter with a diameter of 25 mm. Consequently, the distance to the camera is 200 mm. It is important that the geometrical centers of both components are positioned along the same axis and that they stay parallel to each other.

In addition the following settings on the camera are necessary:

- The grey level resolution (number of bits per pixel) must be as high as possible. Through a higher bit number the ADC receives more steps to discretize the analogue signal. The higher the resolution, the lower the quantization noise.
- The amplification must be as low as possible but high enough to ensure that the noise is greater than or equal to one grey value.
- The Offset (Black Level Calibration) must be as low as possible but high enough to ensure that the signal in darkness is greater than or equal to one grey value.
- No automatic corrections and/or settings may be used.
- The measurement has to be executed in the linear mode of the camera.

Signal and Noise

According to standard EMVA 1288, the signal of an image is represented by the average of all grey values of the image. This average is calculated with the following equation:

$$\mu_y = \frac{1}{N}\sum_{i,j} y_{i.j}$$

Two noise sources dominate the amplitude of the signal, the „Photon Noise“ and „Amplifier Noise“. Photon Noise originates from the nature of the light itself. The photons do not hit regularly onto the image sensor. The irregularity is given by a certain mathematical expectation. A Poisson distribution determines this expectation.

The Amplifier Noise is a white noise and is added when the analogue signal is amplified.

Both dimensions belong to the type of temporal noise. Therefore, in order to scrutinize the sensitivity, only the temporal noise needs to be observed. It is calculated with the following equation.

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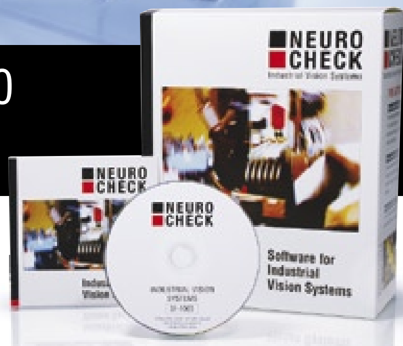

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$$\sigma^2_{y,temp} = \frac{1}{2}\left[\frac{1}{N}\sum_{i,j}\left(y^A_{i,j} - y^B_{i,j}\right)^2\right]$$

The remaining inhomogeneous conditions, the FPN (Fixed Pattern Noise) and PRNU (Photo Response Non Uniformity) are removed by taking the difference from two images. FPN originates from the variation of the dark current from pixel to pixel. PRNU originates from a different photosensitivity of the individual pixels. A local pattern develops, which is why these noises belong to type of spatial noise.

Calculation of Sensitivity

The signal and the noise are the basic factors to determine all data sheet values depending on the temporal noise. The sensitivity is one of the data sheet values that can be calculated. More data sheet values with the calculation formula documented by standard EMVA 1288 are given in table 1.

Table 1: Overview of the results

Quantum efficiency η	46.5	%
Sensitivity D	10.1	e^-/DN
Saturation $\mu_{p,\,sat}$	20500	photons
Total Conversion Gain K	0.099	DN/e^-

The sensitivity shows how many electrons are needed to generate one digital unit. It is calculated with the help of the reciprocal value of the „Total Conversion Gain K" (TCG). The TCG describes a conversion factor between the electrons generated in the image sensor and the digital signal.

$$K = \frac{\sigma^2_{y,temp} - \sigma^2_{y,temp,dark}}{\mu_y - \mu_{y,dark}}$$

Image sensors are dependent on temperature. This means that also a thermal effect releases electrical charges in the image sensor. But here, only the charge caused by light is of any interest. Therefore the signal and the noise are corrected with values from respective dark images.

However, sensitivity is not an independent measurement, but influenced by amplification of voltage. Although this ought to be set as low as possible, it can, however, vary even when using the same image sensors in different cameras. Hence, in this case the amplification should be declared. This is, though, rather contra-productive in the course of the required comparability of data sheets. Comparing the defined signal-to-noise-ratio (SNR) is a sensible alternative. The SNR is calculated as follows:

$$SNR = \frac{\mu_y - \mu_{y,dark}}{\sigma_{y,temp}}$$

Because the noise is enhanced as strongly as the signal, it is eliminated by creating the quotient. Thus, it can be determined how many photons are necessary in order to achieve a defined illumination.

Test Procedure

The images for the evaluation stem from two series. First a series with a defined illumination is taken at varying exposure times. Variation of exposure times must include from area SNR = 1 up to the saturation area of the camera. Also, it is necessary to provide two images (see signal and noise) from every exposure time.

Once the illuminated series is finished, it is most feasible to switch off the lighting and start the second series with the same exposure times (see calculation of the sensitivity).

The signal and the temporal noise are calculated for all images.

Measuring Results for Sensitivity

For graphical representation of the TCG, the corrected temporal noise is plotted versus the corrected signal. The gradient of the best-fit line through all points represents the TCG. In this example it is K = 0.099 and the matching reciprocal value D = 10.1e^-/DN.

Figure 2 shows the comparison of the SNR. The ratio of the comparison is 40:1. According to ISO 12232, this can be considered as an excellent illumination. In a graph along logarithm dualis this would be an SNR of 5.3 bits. To reach this SNR, approx. 2,900 photons are necessary.

An overview of the results dependent on temporal noise is shown in table 1. These results are based on the wavelength 617 nm, which was chosen, because it is the standard wavelength of the integrated LED light of the examined camera hardware.

Table 2 shows the derived parameters.

Table 2: Derived results

SNR	46.5	%
DYN	9.86	Bit
Absolute sensitivity threshold $\mu_{p,\,min}$	22	photons

It can be concluded that introducing a standardized data sheet for cameras is an important step. Not only is it an advantage for users to choose the right camera for an application, but it also offers a benchmark possibility for suppliers developing new products.

Pepperl+Fuchs is able to compare different camera configurations in a fast and efficient way with the described measurement set-up. During the work for the diploma thesis the standard EMVA1288 could be easily implemented, with very little investments and no problems. The quoted literature in the standard was of great help.

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International GenICam Meeting in Munich

From April 21 to 24, 2009, the "GenICam & GigE Vision Technical Meeting" took place in Munich, Germany. The event with machine vision experts from all over the world was hosted by the Munich Software manufacturer MVTec Software.

26 participants from 17 companies and organizations came to Munich to push the progress of the industry standards GenICam and GigE Vision. The aim of these standards is to clearly ease and unify the image acquisition as well as the configuration of industry cameras. "This is highly desirable for users as well as manufacturers," says Christoph Zierl, MVTec's product manager and organizer of the meeting.

So far, every camera manufacturer provided an own proprietary programming interface for parameterization and image acquisition. However, the GenICam standard enables to control the complete functionality of any camera via a common generic programming interface. Meanwhile, this standard has become very popular, because it is mandatory for all cameras and applications which are compatible to the established GigE Vision standard.

The GenICam GenTL standard even goes one step further: This standard defines a software interface between a "GenICam GenTL Producer" and a "GenICam GenTL Consumer". Therewith, any camera may be chosen for machine vision applications without the need of programming some specific adaptation. Here, it doesn't matter whether the camera is connected via Gigabit Ethernet, USB, IEEE 1394, or Camera Link. Thereby, the comprehensive „GenICam Standard Feature Naming Convention" cares for a unique naming of the available camera parameters.

Primarily, the publication of the GenICam modules 1.2 and GenTL 1.1 (release planned for autumn 2009) was discussed during the meeting. The GigE Vision standard will be expanded in such a way that also non-streaming devices can be addressed by this protocol.

All in all, the participants agreed that the standardization of image acquisition interfaces and protocols leads to a considerable added value for all stakeholders, as no proprietary connections have to be developed and maintained any more.

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Retrofit Design Dragon Style

Easy Conversion to Modern LED Line Lights

Up to now a combination of a DC-stabilized halogen light source and a fiber-optic line converter has been the optimum lighting installation for numerous line scan camera applications. Despite its good performance characteristics, demands for uncomplicated and cost-effective LED lighting are being heard more often for various reasons. Swiss lighting specialist Volpi has now responded to these demands with the new Dragonline LED line light.

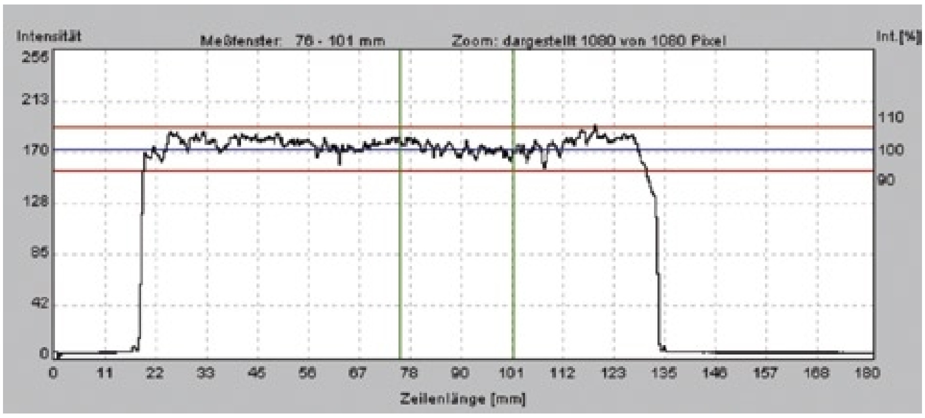
Volpi offers complete conversion from conventional glass-fiber lighting to LED lighting with high performance and cost efficiency, in addition to replacement of halogen light sources with high-power LED light sources. The company, based in Schlieren near Zurich, would like to make this conversion as easy as possible for its customers.

Modernized

Thanks to their retrofit design, the new LED Dragonlines have identical housing geometries to those of the well-known Volpi fiber optic light lines. This compatibility allows existing fiber optic lines to be taken out of the system and the new LED line lights to be integrated at the same position using the same mounting material. The new lighting is ready for use immediately after connection to the power supply and the user quickly has sustainable, high-power and energy-saving line lighting. According to Michael K. Friedrich, Machine Vision Business Unit Manager at Volpi, the advantages of the Dragonline lie in its adaptation to highly sophisticated applications: "Innovative demanding line camera applications require a high-quality lighting system characterized by extremely good homogeneity and outstanding intensity. The Dragonline offers these characteristics and much more, for example excellent long-term stability, low power consumption, application-optimized thermal management and a virtually unbelievable light transmitter service life. Lens attachments adapted to the application and optimized micro-lens diffusers with low light loss allow for application-optimized use in bright field and dark field."

Individualized

The flexibility in length selection is nearly limitless. Due to cascading LED PCBs, the Dragonline can be built modularly in 75 mm steps. A further 35 mm for side housing parts for each length and a D-SUB Mixed 7W2 port integrated on the side are given. The standard light output width is 1.1 mm. The light color can be optimized according to the application. There are currently ten different power



Dragonline shows very good light uniformity values of +/– 10 % over the whole line length. A cos4-effect falloff at the edges will be corrected by light distribution.

LEDs available. Apart from three shades of white ('cold white', 'white' and 'warm white'), the colors red (625 nm), amber (617 nm), yellow (590 nm), green (528 nm), blue (470 nm) and NIR (850 nm and 940 nm) are available for the Dragonline. A cylindrical 18 mm focusing lens is available for every length.

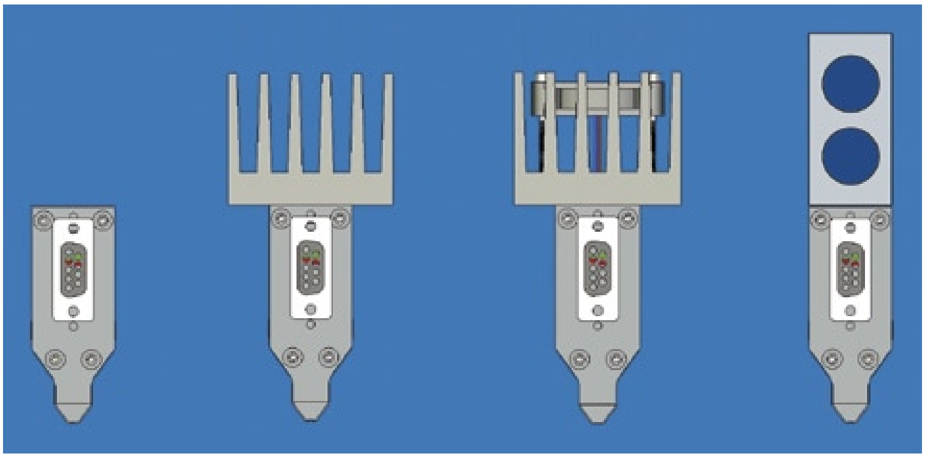
Performance-oriented

Depending on the required luminous intensity, the Dragonline can be configured with any of four different intensity levels. At the first level in this thermal management design, the Dragonline is cooled solely passively via the housing and the lighting can be operated at 25 % of maximum overall intensity. This level corresponds to an illuminance of 110 klux in a dark field application with a working distance of 20 mm. The other three intensity levels – extended passive cooling with additionally mounted cooling element, fan cooling and closed circuit water cooling – allow the intensity to be increased in 25 % steps up to the maximum level. Apart from the enormous luminous intensity and the high degree of individualization, the very good homogeneity values of +/– 3 % over 20 mm length are immediately convincing. With an external voltage dimmer, the lighting can be dimmed in the range of 10–100 %. The Dragonline can also be operated with external flash control via the integrated TTL input.

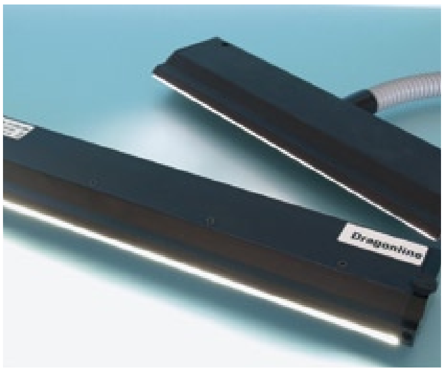
Cost-optimized

In comparison with a DC-stabilized halogen light source, the innovative LED line light offers enormous savings potential. A 300 mm Dragonline with high-power white LEDs consumes just 24 watts at the first intensity level. The halogen light source consumes 200 watts on average – more than eight times as much. In the water-cooled version, in which the Dragonline can be operated at 100 % intensity, the savings are still slightly above 50 %.

The service life of the Dragonline can reach more than 50,000 hours, depending on the LED light color. This means that the LEDs are expected to only have around 50 % of their original illumination intensities after this operating time. Because of the extremely long running time of modern LED components, regular lamp replacement (as is necessary, for example, every 200–2,000 hours with a halogen light source) is eliminated. The failure frequency of a halogen lamp depends on the lamp type and selected intensity at which the light source is operated. Frequent on/off switching also has a detrimental effect on the service life of a halogen lamp. Costs arise for purchase of the numerous replacement lamps as well as for maintenance and machine downtime as usually the entire process must be temporarily stopped during lamp replacement. The overall profitability of the new LED line lights is many times higher than that of conventional line lights.



From left to right: Dragonline without forced cooling, with optional heat sink element, forced cooling with fans and liquid cooling: Intensity increases in steps of 25 %



The new LED-Dragonline (front) in comparison with a Volpi fiber optic lightline in the background

Swiss Precision

Volpi provides fiber-optic and LED lighting components for use in machine vision, microscopy, forensics and medical diagnostics. Development of fiber-optic sensors for customized applications comprises another business area. With locations in Switzerland and North America, Volpi sells their products worldwide through a dense network of regional sales partners.

Application-oriented

According to Michael K. Friedrich, Volpi is especially targeting applications requiring particularly high luminous intensities with their new line light: 'The compact cascading mechanical properties meet the tough industrial demands for high-speed systems in the area of steel-aluminum-paper web products and for mail sorting applications and banknote inspection systems. Moreover, the Dragonlines are excellently suited for print inspection applications and as lighting for surface inspection applications.'

Conclusion

Especially in economically difficult times every company carefully scrutinizes their current cost situation. Conventional halogen lights all too frequently reveal themselves to be inefficient power devourers on closer inspection. In most cases investment in modern powerful LED lights pays off directly after commissioning. With Dragonline, Swiss lighting specialist Volpi has introduced innovative LED line lights with outstanding optical characteristics providing a further possibility to lower operating costs to the market.

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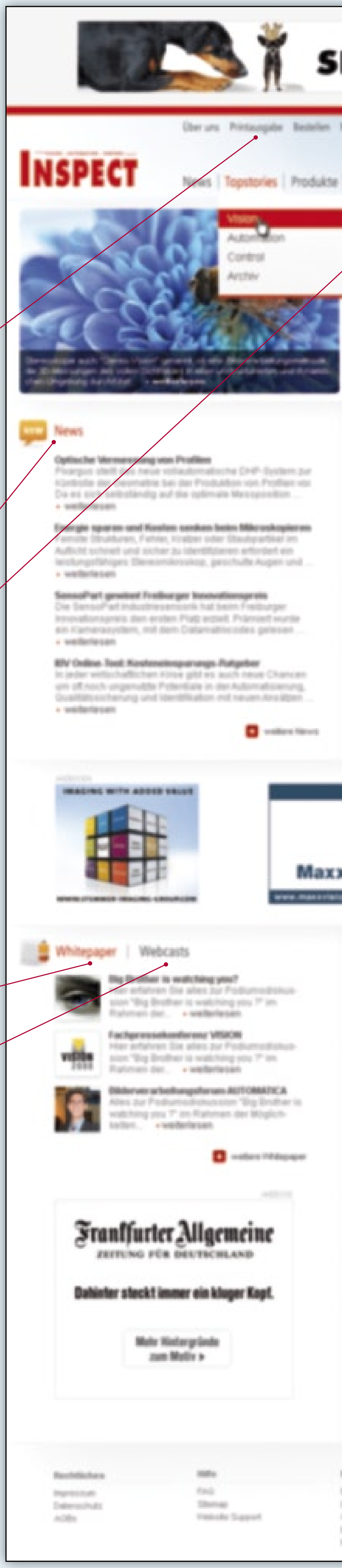
www.inspect-online.com – Relaunch in June 2009 Offers New Valuable Features

Online Portal

for Machine Vision and Optical Metrology

INSPECT, the leading European b2b print and online media for machine vision and industrial optical metrology, upgraded its industry portal www.inspect-online.com to include numerous enhanced features. The new website will start in June 2009.

inspect-online.com serves information adapted to its readers needs for business and education. Furthermore, it offers fast and comprehensive access to up-to-date briefings in machine vision and optical metrology. This eases work, safes time and, stands for a considerable surplus value for the daily work of the target groups' specialists and executives.



ePaper

The INSPECT journal is now online available as an ePaper version including a full text search for relevant information. This presents a great value in addition to the printed version.

Industry News

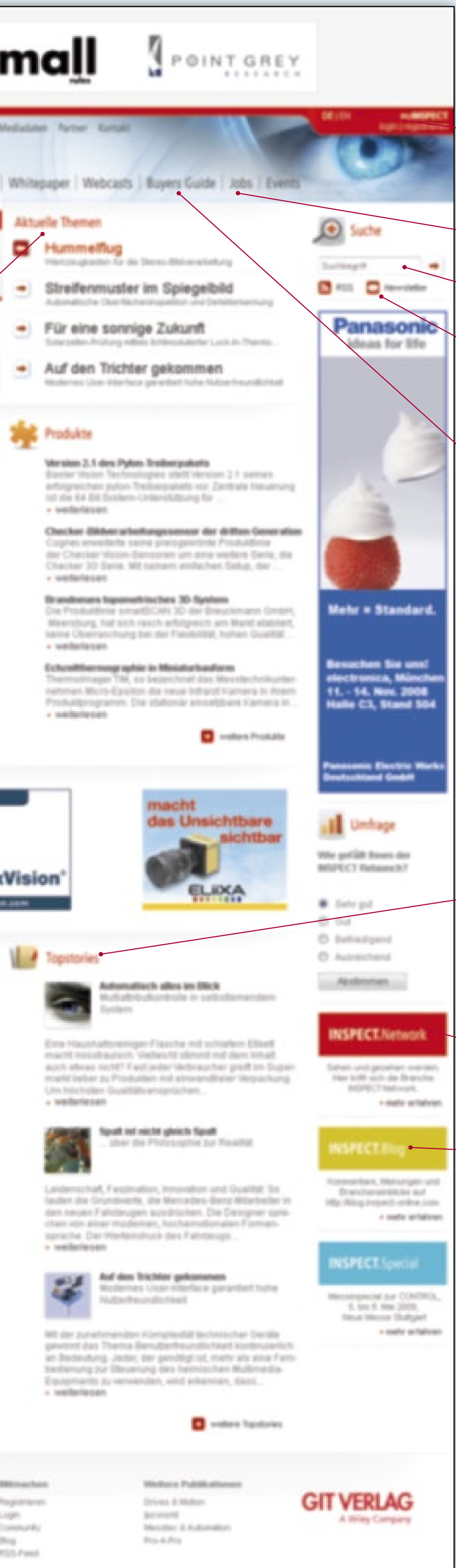
Up-to-date daily news for business, particulars, joint ventures, mergers & acquisitions, awards, market data, reports from the associations, trend topics, trade show previews and reviews, and further industry information are available at INSPECT online news.

Whitepaper

Detailed information on current trends and new products will be presented as case study, user report, market study, and analysis in PDF format and available for online view and download, respectively.

Webcasts & Webinare

Webcasts – webcasting is "broadcasting" on the "web" – provide information using video and audio files to perform a multi-media-based information on relevant news, insights, and products. A special application of webcast is the webinar, an interactive online seminar with live event character. It combines image sequences with audio content and presentations. The live webinar even allows for interaction between author and audience. The new INSPECT portal offers webinars to specific issues. It is an attractive and efficient way for your further education.



Internationality

In line with the INSPECT magazine, also the new web site features a German and an English version.

Full Text Search

Keywords based quick search within the entire web site.

Jobs

Continuously updated job portal for highly motivated industry specialist and executives.

Buyers Guide

International online database for components, products, systems, and services concerning machine vision and optical metrology. The visitors will get a comprehensive and complete overview of vendors and products. Get always the appropriate vendor, partner, and solution provider at one mouse click.

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Up-to-date industry news can be received as a free newsletter or RSS feeds. This way all new data will be present at your desktop without delay.

Top-Stories

Current top stories focused on vision (components and technologies), automation (measurement, inspection, identification, guidance), and control (material inspection and measuring instruments).

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Comments, opinions, and insights into industry and business at http://blog.inspect-online.com.

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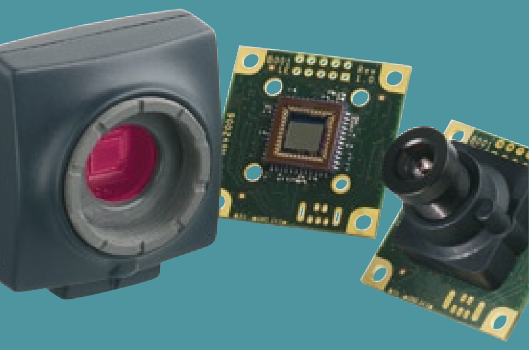

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Leica Microsystems Reports Record Sales

For the first time in its history, Leica Microsystems' annual sales volume for 2008 exceeded the billion US$ mark, reports the international high-tech microscope and scientific instrument manufacturer and distributor, headquartered in Wetzlar. "Over the last two years, we have seen a dramatic increase in the demand for our products throughout the world. In most of the markets in which we operate – including biomedical research, clinical applications, industry, microsurgery, and histopathology – we have achieved double-digit organic growth rates. Moreover, we have substantially expanded our product breadth through a number of strategic company acquisitions," comments Dr. David Martyr, President of Leica Microsystems. Leica Microsystems was purchased by Washington D.C.-based Danaher Corporation in the summer of 2005. Since that time Leica Microsystems has acquired and integrated eight companies in Australia, Europe, the US, and Asia.

www.leica-microsystems.com

GigE Vision Version 1.1 Interface Standard Released

The GigE Vision camera interface standard that has been used by the machine vision industry since 2006 has been updated and Version 1.1 is now available. The GigE Vision standard committee has improved the standard and Version 1.1 includes new features. Additionally, the standard – which was originally released only in English – is now also available in Japanese. The trademark process is now fully complete and the Automated Imaging Association (AIA), the global trade group that oversees the ongoing development and administration of the standard, has been issued a registered trademark. GigE Vision is a camera interface standard developed using the Gigabit Ethernet communication protocol. It is the first standard to allow fast transfer (1,000 Mbps) of data using low cost standard cables over very long lengths (up to 100 m).

www.machinevisiononline.org

EMVA Signs Cooperation Agreement

On the occasion of the MV China trade exhibition in Shanghai, the Chinese Mechanical Engineering Society (CMES) and the European Machine Vision Association (EMVA) signed an agreement on March 24, 2009, in order to establish and to expand their future cooperation. The focus of the cooperation will address most areas of association work and includes public relations, regular exchange of information, mutual support in organizing conferences and industry delegations, standardization as well as market analysis and statistics. In this context, EMVA will assist to establish an annual machine vision survey for China with a view to global harmonization of machine vision statistics. Furthermore, EMVA has reinforced its partnership with the annual MV China exhibition in Shanghai. At the MV China 2009, the EMVA organized a successful industry delegation to the exhibition for the first time.

Overall the agreement emphasizes the economic importance of the Chinese market for the machine vision industry. Machine vision has become a key technology for the Chinese manufacturing sector which is also reflected by the fact that the CMES has recently launched a Machine Vision Group.

During the ceremonial signing Gabriele Jansen, President of EMVA, commented: "The Chinese market for machine vision products and equipment gains more and more importance for a lot of EMVA member companies. I am very happy that in CMES we found a cooperation partner that represents machine vision companies, research institutes and end users of the technology as well. The increase and the new quality of our information exchange and mutual support will benefit the members of both our associations significantly."

Mr. Zhang Yanmin, General Secretary of CMES, said: "There is a great potential for Machine Vision in industry. CMES has built a close relationship with EMVA. Both parties will benefit from this. And I do hope that we can explore the Chinese market together by means of exchanging information and recommending advanced technologies from Europe and other parts of the world to China for companies."

www.emva.org

AVT Expands North American Operations

Allied Vision Technologies announced the expansion of its North-American operations at the Vision Show which took place in Phoenix, AZ, from March 31 to April 2. Following the acquisition of Prosilica of Canada in July 2008, the leading camera manufacturer increased the floor space of its US-Subsidiary in Newburyport, MA, and strengthened its sales team with two new representatives. AVT's US-subsidiary, has assumed responsibilities for sales activities in North America for both AVT FireWire cameras and Prosilica GigE Vision cameras. The headquarters located in Newburyport, MA has added 30 % more space. AVT now occupies all three floors of the building with offices, warehousing, and technical support. The additional space is fueled by AVT's sales and product growth in North America.

www.alliedvisiontec.com

New Distributor for Spain, Portugal, and Latin America

From April 2009, the distribution of MVTec machine vision software products in Spain, Portugal, and Latin America (Mexico, Brazil, Chile, Colombia, and Argentina) will be performed by Infaimon. Besides the distribution of Halcon and ActivVisionTools, Infaimon will also provide high-level technical support for these software products. The beginning of the distribution cooperation is carefully adjusted to the launch of the new Halcon 9.0 version in 2009. It offers numerous worldwide novelties and unique selling propositions to machine vision. "Spain and Portugal are increasingly evolving to outstanding industrial markets", states Dr. Olaf Munkelt, MVTec's managing director, "and Latin America has a big potential for industrial development. Thus, MVTec wants to expand its sales activities in all these important countries."

www.mvtec.com • www.infaimon.com

Flir Systems: First Quarter 2009 Financial Results

Flir Systems announced financial results for the first quarter ended March 31, 2009. Revenue was $ 272.0 million, up 15 % compared to first quarter 2008 revenue of $ 236.9 million. Operating income in the quarter was $ 83.4 million, up 51 % from $ 55.1 million in the first quarter of 2008. First quarter 2009 net income was $ 54.3 million, or $ 0.35 per diluted share, compared with net income of $ 36.5 million, or $ 0.24 per diluted share, in the first quarter a year ago. Cash provided by operations during the quarter was $ 74.3 million. Revenue from the company's government systems division increased 43 % over the first quarter of 2008, to $ 162.2 million. Revenue from the company's commercial vision systems division increased 5 % over the first quarter of last year, to $ 45.9 million, revenue from the company's thermography division decreased 20 % from the first quarter of last year, to $ 63.9 million.

www.flir.com

Significant Reductions

The downturn in economic and industrial activity will have a significant effect on sales of machine vision hardware, according to IMS Research. As a result, market forecasts published in May 2008 have been revised to reflect the current market conditions. In the fourth quarter of 2008, machine vision companies saw, on average, their sales fall by 15 % from the fourth quarter of 2007. Some have seen up to a 50 % decline in sales revenues in the first two months of 2009, although there are great variations depending on the industries they serve. As a result IMS Research has reduced the worldwide forecast for machine vision hardware (2008–2009) from growth of 7 % to a revenue reduction of 13.4 %. Sales to automotive, semiconductor and related industries are the worst affected. Sales to medical and infrastructure-related industries are faring better than most at present; this is expected to continue, despite the longer lead times associated with infrastructure projects.

www.imsresearch.com

Dalsa Reports First Quarter Financial Results

Dalsa reported revenues from continuing operations of $ 37.9 million for the quarter ended March 31, 2009 in comparison to $ 54.2 million for the first quarter of 2008 (-30.0 %) and net income from continuing operations of $ 1.3 million in comparison to $ 5.7 (-76.7 %) or $ 0.07 per share, diluted. Standard product gross margin percentage is 35.5 % in comparison to 45.3 % in the first quarter of 2008 (-9.8 p.p.). "In the first quarter, as anticipated, the dramatic downturn in the global economy had a negative impact on our financial results," commented Brian Doody, Chief Executive Officer. "Our Digital Imaging business was hardest hit, as we saw a sharp decrease in demand from Asian OEM customers involved in semiconductor, flat panel, and electronics manufacturing. In our Semiconductor business, despite another record quarter of MEMS shipments, we saw a more moderate decline in revenue, due largely to an expected decrease in demand for CMOS wafer processing."

www.dalsa.com

Henrik Ilsby Rejoins JAI to Lead Sales & Marketing

Henrik Ilsby (51) has been appointed senior VP for global sales and marketing at JAI, a worldwide provider of camera solutions for industrial, scientific, medical, defense, traffic, and other applications. Ilsby will be based in JAI's Copenhagen office and will drive the company's sales and marketing activities through regional sales and marketing teams in Europe, the Americas, and Asia. Ilsby is well known within the automated imaging community having spent 13 years with JAI, starting in 1994 as director of sales, and quickly rising to vice president, then senior vice president for worldwide sales of JAI's camera business. His prior industry involvement included not only significantly growing JAI's CCD camera business, but also serving as a board member of the Automated Imaging Association (AIA).

www.jai.com

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Scanning Objects Fast and Wide

3D Laser Scanners Register Areas in Wide Range

Dr. Bernd-Dietmar Becker, Director of Laser Scanner Marketing & Product Management for Faro, introduced two new 3D laser scanners at the last press conference in Germany. Both new models (Photon 120 and Photon 20) feature measuring rates up to 976,000 points per second. They provide an eightfold increase in speed and double the distance scanning capacity of the previous generation. The Photon 120 offers an operating range of 153 m, whereas the Photon 20 has been designed for scanning objects within a range of 20 m. “The long range of Photon 120 eliminates the need to reposition the device in most application scenarios,” stated Dr. Bernd Becker. With the new hardware the company also introduced the latest version V4.6 of its scan processing software Faro Scene. This software automates registration of the data captured by the scanner, that is, its target recognition, naming and matching. “As a result, in an average imaging project involving 300 scans, labor input can be reduced from several days to only a few hours for end control and troubleshooting,” added Dr. Becker. Delivery of the new offerings will begin this summer and an upgrade path from previous generation Faro Laser Scanners will be available.

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25th Anniversary of Fanuc Vision

Long-term Strategy Pays Off

In 2008 Fanuc Robotics Germany significantly surpassed the 2,000 sold robot's mark. According to Fanuc Germany CEO Gerald Mies the company has thus clearly made number 2 in the German market. For him the chance to get to this position again this year is quite realistic. One building block for the success of the company might have been the very early decision to consider vision technology as core competence of the robot.

Despite the fact that the economic crisis did manifest itself in the form of decreasing order income in Q4 of 2008, Fanuc Robotics Germany still managed to grow their revenue from about € 65 million to close to € 80 million in 2008. At the same time the number of employees went up 15 % to 80 persons total. These numbers were presented by Fanuc CEO Gerald Mies at a press conference in Neuhausen, Germany.

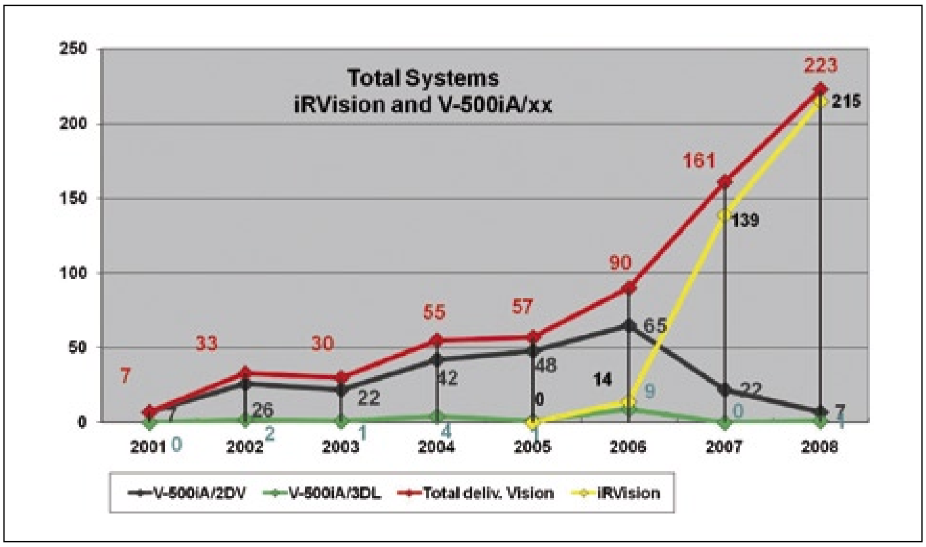
Almost all industry sectors contributed to this success with similar growth rates. Especially successful, however, has been the companies' dedication to the Tier-1 automotive suppliers and the food industry, respectively. The wide spread commitment to a diverse range of target markets now somewhat smothers the risk of single industries slump. Gerald Mies: "All industries react with more or less restraint to the crisis." Dubbed as "new venture" by many players on the market, the food industry is a field of increasing robot adoption for the supplier from Neuhausen. "We attend to this market segment for some time now. McDonalds, Ferrero or Lindt & Sprüngli, to name only some, are committed robot users for several years already." The crisis is seen by Gerald Mies also as opportunity: "Now more than ever, we can discuss strategy with our customers. In most companies in almost every branch of the industry the automation potential is far from being exhausted." For Fanuc Robotics and their system solution partners this means that further convincing has to be done. Mies: "The need is there."

Fanuc CEO Gerald Mies: „The need is there."

2009 is also a year with a special anniversary for Fanuc: 25 years of Fanuc Robot Vision can be celebrated. Fanuc, as one of the first robot suppliers worldwide, decided as early as 1984 to make their robots see by implementing machine vision. The main requirement back then was the detection of the part position, e.g. the vision functionality was seen as technology module to enhance the flexibility of the robot and to enable the robot to take on new and additional tasks. This main goal remains unchanged up until today, after 25 years of successful deployment of Vision Robots. Any additional functionality added during this time, mainly identification and inspection tools, serves as enhancement of the 2D and 3D localization of parts with the goal to increase the range of applications and the efficiency of the robot compared to other brands.

According to Gerald Mies the know-how and experience acquired in machine vision is a perfect entry point for in-depth discussions with customers. "25 % of our robots are sold because of our expertise in vision," states Mies.

Naturally, the company views the next steps in vision development exclusively in connection to the robot. Machine vision applications apart from the robot are not a target. The next goal, in fact, is to combine vision and servo robotics.



Out of approx. 5,000 robots sold in Europe in 2008, 223 units have been delivered with the integrated vision system (Source: Fanuc Robotics Germany)

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Clean Slate

Image Processing Basics: The Background

Image processing in industrial applications often is much simplified when the lighting device provides an image with a homogeneous background. Such a situation allows for robust, stable segmentation of foreground and background. This article deals with some simple methods of image processing which may be useful for the examination of a lighting system.

The purpose of lighting in industrial image processing is to enhance the relevant features of objects and to mask those properties which are of no importance or might even produce unwanted effects. The simplest case would be a lighting device which produces a nearly binary image with clear contrast between objects and background. Figure 1a shows a typical example. Most application engineers are quite satisfied when the grey level image can be transformed into a proper binary image by means of a single global threshold which may be chosen from a broad interval without producing significant deterioration of the segmentation. Such a situation usually is evaluated by analysis of the grey level histogram. Figure 1b shows the histogram for figure 1a. This is a nice example for a bimodal distribution with two clearly separated features. One cluster around grey level 25 belongs to the pixels of the dark objects; the other cluster around grey level 215 is formed by the pixels of the background. Global thresholding with the grey level 104 results in the binary image in figure 1d with clear segmentation of objects and background.

Distribution of Grey Levels

We thus seem to look at an ideal lighting solution. In detail, however, the situation turns out to be a bit more complicated. Since figure 1a shows several coins placed on a backlight-device, the histogram should feature just two sharp lines corresponding to the dark coins and the bright background, respectively. What we observe, however, are two clusters with a width of about 20 grey levels. Figure 1c reveals even more structure in the grey level distribution. The ordinate shows the square-root of the number of pixels with the corresponding grey level rather than the number itself as in figure 1b. This representation shows that for every grey level between the two prominent clusters at least some pixels can be found in the image. One reason for the appearance of these grey levels is the special situation at the edge of the coins, where reflection, shadows and the optical properties of the lens contribute to a continuous intensity profile of the edge, which is sampled by the discrete grid of the detector in the image-plane of the camera. Signal noise as well as differences in sensitivity from pixel to pixel and the variation of the dark signal ("fixed pattern noise") also contribute to the scatter of the grey levels.

The grey level distribution of an image with objects on a background is a useful tool for the evaluation of the general situation, but it is not well suited to qualify the illumination. When the objects are removed from the scene, however, the properties of the lighting-device should show up more clearly. As an example, Figure 2a shows a small background region clipped from figure 1a. The main feature in the corresponding histogram is a bell-shaped cluster in the interval between the grey levels 206 and 225. There are no other grey levels in the

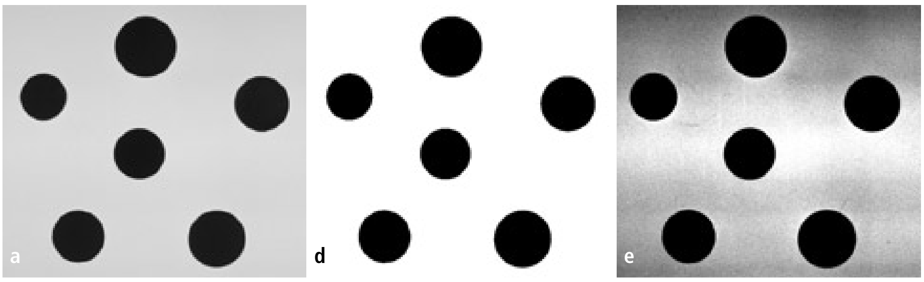
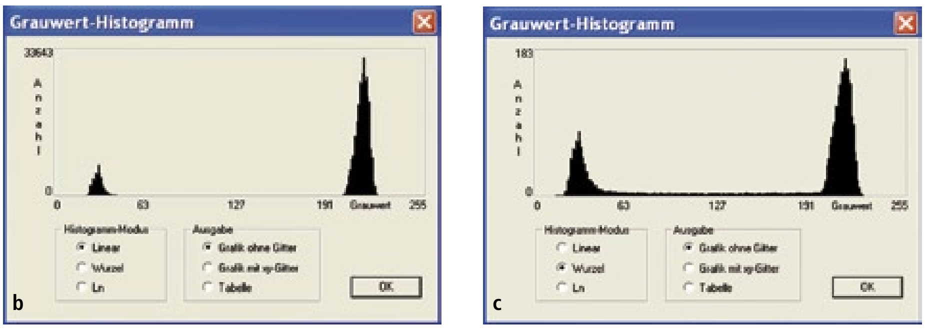


Fig. 1: An image of coins on a back-lighting device, the corresponding grey level histogram with linear and square-root scaling, the resulting binary image and the result of a stretching operation for contrast enhancement



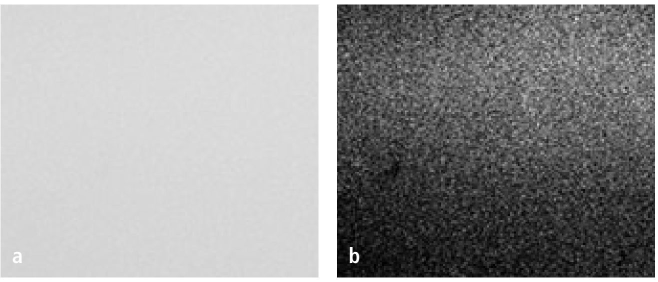


Fig. 2: A small section of the background from figure 1 and the result of a grey level stretching

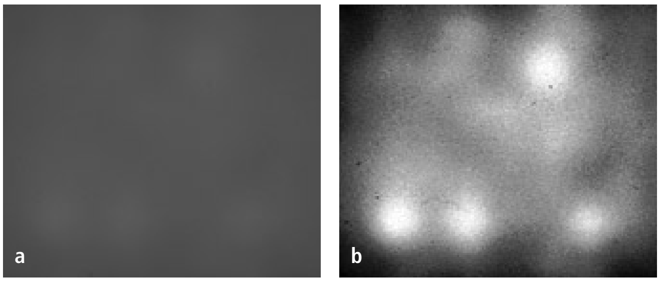


Fig. 3: An image of a commercial back-lighting device and the result of a grey level stretching

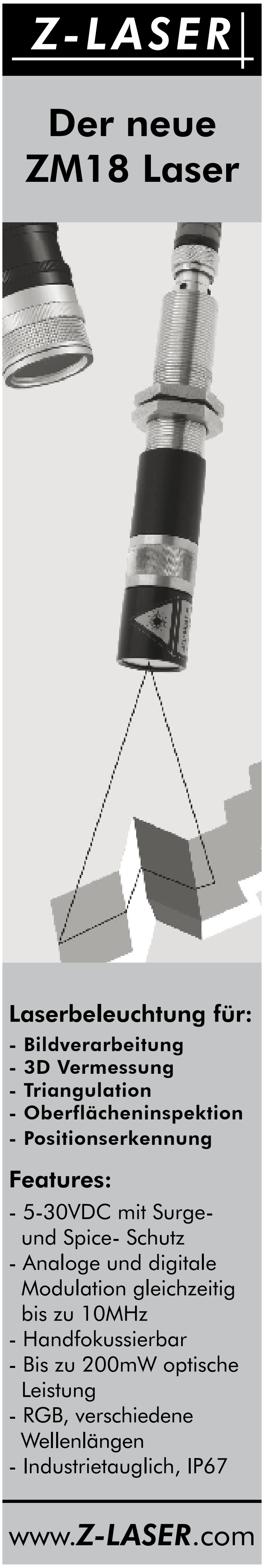
whole clipping outside of this interval. The range is only 20 grey values, the median is 216, and the standard deviation is 2.7. These global statistical parameters or rather these values normalized to the centre of the distribution may thus be very well suited for the quantitative characterization of the lighting solution.

Local Structures

Local structures in the image, however, often have no direct influence upon the values of global parameters. Even for images like figure 2a with seemingly very favorable statistical parameters a closer look may reveal surprising features. Figure 2b shows the result of a simple contrast enhancement operation, a so called window-leveling or stretching. In this example, the grey levels between 210 and 225 are stretched to the full range available, that is all values smaller than 211 are set to 0, all values larger than 224 are set to 255, and the values in between are linearly mapped to the range from 0 to 255. Small differences between grey levels thus become more distinct for a human observer. The illumination is by no means homogeneous, and there are not only granular statistical fluctuations in the background, but also some dark spots and broad darker and brighter zones. The whole extent of these variations shows up when the contrast enhancement is applied to the whole image like in figure 1e, where the grey level interval between 190 and 220 has been stretched to the full range available. A number of unwanted effects and structures appear, and global statistical parameters will most probably not be sufficient to characterize such features. A further, quite spectacular example is the commercial back-lighting device producing the image shown in figure 3a. Grey levels range from 59 to 93 with a standard deviation of 5.1. These values seem to be not very alarming, but the stretching-operation for the interval from 70 to 90 shows some quite strange structures as can be seen in figure 3b.

Manifold Influencing Factors

It should be noted that these procedures do not characterize the lighting solution as such, but rather the combination of lighting, optical imaging and the influence of the detector and its electronic signal processing. Optical distortion, e.g., may result in different detector signals for different regions of the object plane even if the illumination is perfectly homogeneous. Furthermore, several lenses routinely used for industrial image processing show a significant drop of efficiency towards the outer regions of the image plane compared to the centre. In the long run, you will always have to deal with the optimization of the image formation as a whole. A holistic view at the problem thus seems to be quite efficient as long as experience provides some hints to the reasons for and consequences of specific effects. A continuous variation of the intensity through the image plane, e.g., sometimes will cause no trouble at all. Image processing based on edge detection, e.g., will usually not be sensitive to such deviations from an ideal intensity distribution. Most image processing methods just need local contrast, since algorithms usually utilize local differences



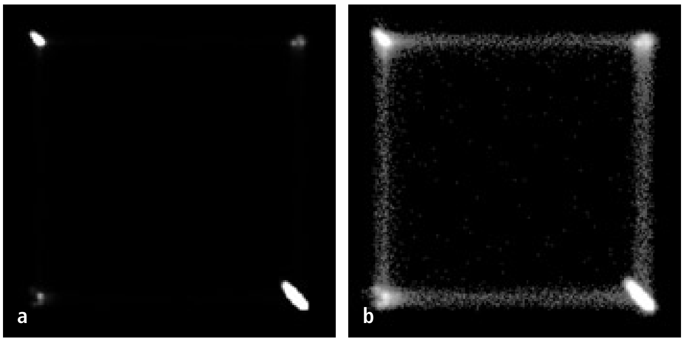


Fig. 4: The co-occurrence matrix for the image in figure 1 and a non-linear mapping for enhancement of further structures in the matrix

between grey levels rather than long-range properties.

Lighting thus must not produce artifacts which may be interpreted as local contrast although there is no corresponding feature in the real scene. Such artifacts, however, may appear in numerous variations, similar to the situation in surface control with its huge number of different scratches, craters and other faults which can not be completely described in advance.

Systematic Analysis Methods

As a systematic approach, a gradient-image may be well suited, which maps the local slope between the grey levels of adjacent pixels. Methods borrowed from texture analysis also may be appropriate for this purpose. As an example, figure 4a shows the so-called co-occurrence matrix for the image in figure 1a. On both axes, the available grey levels are plotted, in this case the range from 0 to 255. To construct the matrix, the grey levels of every pixel and its neighbor are determined. If the actual pixel has the value 100 and its neighbor has the value 120, e.g., the counter for the position (100,120) in the matrix is incremented by 1. A perfectly homogeneous distribution, where all the pixels in the source image have the same grey level, will thus result in a co-occurrence matrix where a single element only will be different from zero, showing up as a bright spot on a black background in a representation of the matrix as an image. The matrix shown in figure 4a, however, is a bit more complicated. There are two bright regions on the diagonal, corresponding to the homogeneous dark regions of the objects and the bright background, respectively. On the other diagonal, there are two weaker regions corresponding to the edges of the objects, produced by the paths from the background into the object and vice versa, respectively. This matrix was not constructed by analysis of the grey level of the direct neighbor of a pixel, but of the pixel 16 steps to the right and 16 steps downwards. The influence of the edges is enhanced by this modification. In figure 4b, the matrix has been modified by a non-linear stretching operation. The intensity of the regions thus is no longer a linear mapping of the number of counts in the matrix. This procedure emphasizes further structures in the matrix which in turn reflect the existence of further local grey level steps in the image. This representation may be useful for the determination of a tolerance region for a grey level threshold in a binarization operation, for the design of an adaptive threshold or for considerations concerning edge detection. The local variations of a background image may also be further characterized on the basis of these data. The co-occurrence matrix, however, is a complex construction. It is reasonable to try to extract some parameters which might be suited to evaluate the grey level distribution in the background of an image in the context of a specific application. A simple procedure would be to define a region around a certain area of the diagonal and to check whether all non-zero elements of the matrix are within this area. Other useful parameters have been developed for texture analysis and are described in the literature [1].

Reference

[1] Gonzales, R.C., Woods, R.E., Digital Image Processing, Addison-Wesley 1993, p. 508 ff.

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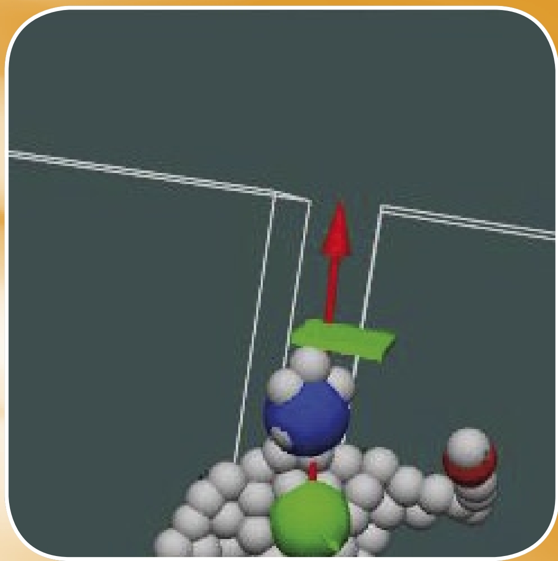
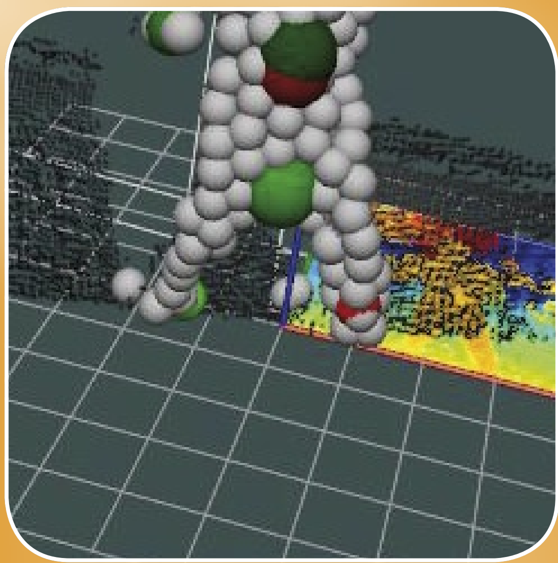
Vision





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.

Custom-made Off-the-Shelf

User Interface of Machine Vision Software in Automated Inspection

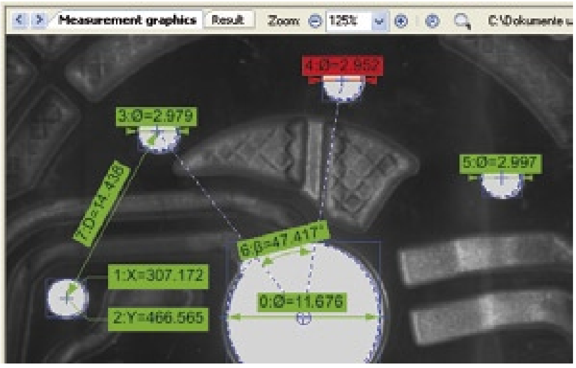
Machine vision systems for nontrivial inspection tasks in automated production processes usually exhibit a high degree of technical complexity. The best machine vision algorithms are useless, however, if the user is unable to operate the system properly. Poorly designed user interfaces quickly lead to the operator being overwhelmed and might endanger the smooth production operation. This results in higher costs because of erroneous inspections, downtime and service that can easily reach a multiple of the inspection system's original purchase price.

The user interface of a machine vision system must be as transparent as possible and as detailed as necessary when it comes to displaying what the system is doing and what means of interaction are available. What is important, though, is that the high degree of internal complexity is shielded by an exemplary and intuitive guidance of the user.

Basically, the user interface has to address two different user types [1]. One of these types is the (usually) highly qualified applications engineer who – besides selecting the cameras and optical components – develops an evaluation strategy necessary for a robust solution of the inspection task and configures the software accordingly during the commissioning of the vision system.

After the successful deployment of an inspection line, an operator takes on the responsibility for the system. This person monitors the automated inspection process and, if necessary, changes inspection parameters interactively. Usually, the operator is responsible for a number of different assembly and inspection stations on a line. The operator's knowledge concerning the system and the software behind it is therefore normally not on the same level as that of the applications engineer who commissioned the system.

The operators' requirements on process data visualization and the means for interaction can vary greatly. For various reasons, some companies regard a minimal interface as sufficient: start the automated inspection process, stop it, and display the most important global results. Other users value the option to change many process and system parameters interactively in a comfortable way during operation and prefer an elaborate display of a number of intermediate results.



Operators wish for a clear visualization of process data, e.g. here the measurement line display at each selected zoom level

Shop floor (automatic) operation in NeuroCheck 6.0 featuring Control Panel (back) and Process View (front)

In the following, the possible requirements of the shop floor operation (i.e., the user interface in automatic mode) of machine vision software are viewed in detail.

Requirement: Visualization of Process Data

To care for a system productively, operators wish for the following features:

- Clear arrangement: Visualization of the results, measurement values, and other process data and system states must be clearly structured and well-arranged.
- Diverse display options should be available for showing camera images and visualizing iconic intermediate results of the evaluation process itself. This includes both freely definable zoom settings as well as configurable parameters for additional information made up of overlaid geometrical drawings and text. Font size and color should be freely configurable.
- Disturbances in the system or errors during the inspection run should be located and described unambiguously.
- By visualizing the history of individual measurement values, it should be possible to recognize in time (by visual inspection) whether a production process might be slowly leaving the tolerance range.

Requirement: Interaction

Even in fully automated inspection systems a certain degree of human interaction is needed or desired. For this the following requirements can be stated:

- Upon deployment, the details and contents of the user interface can be freely configured for each inspection process.
- Menu structure and labeling of commands may be adapted to an existing company standard. It is clear what action is caused by each menu item.

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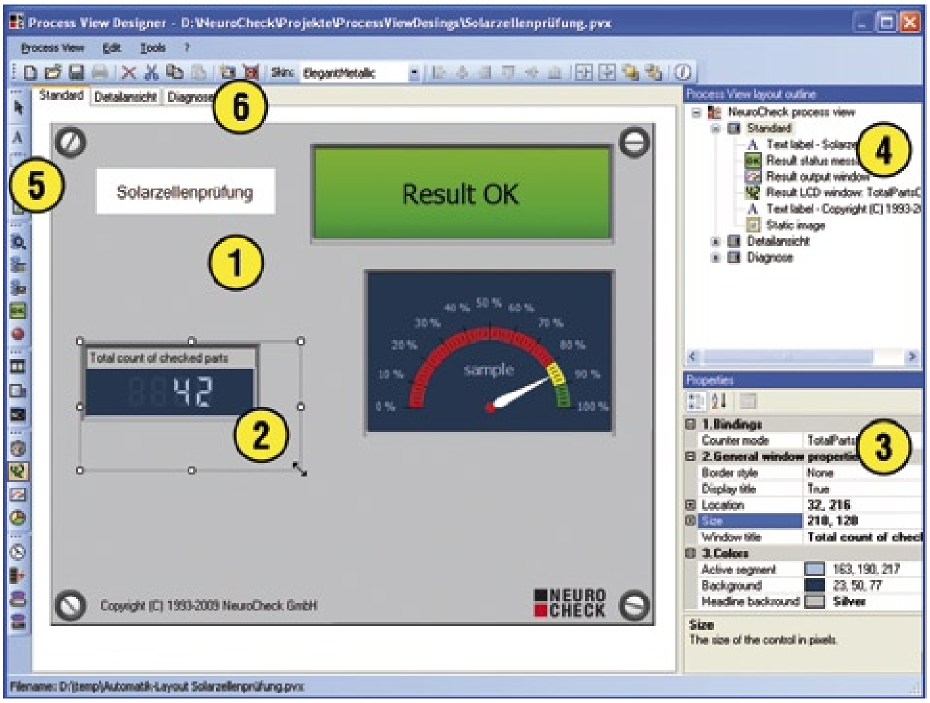

1 Graphical design area

2 Currently selected window under construction

3 Configurable properties of the currently selected window

4 List of all windows in the current design area

5 Tool box for adding new windows

6 Switch to further design areas

NeuroCheck offers with the Process View Designers graphical-interactive designer tools

Hundreds of freely configurable color, font and style settings for the controls allow for the implementation of individual designs of the user interface

- During operation, the level of detail of (process) visualization can be easily switched interactively if necessary, e.g. to display the detail view of the camera position in question for a work piece classified as faulty. Optionally, the system can be operated using keyboard, touch screen or multi touch screens.

Solution: Control Panel and Process View

Irrespective of the purely functional requirements, it is clear to see that users nowadays attach great importance to an „attractive wrapping“, i.e. an appealing and modern design of the user interface.

How can such diverse and, in parts, mutually exclusive requirements on a standard software for machine vision be realized?

Ever since the release of the first software version, it has been the successful approach of NeuroCheck to give the user as much freedom as possible when designing his inspection solution and its user interface. With the new software version 6.0, the possibilities for designing the user interface have once more been greatly augmented.

After analyzing a multitude of customer requirements, we decided to divide the software user interface in the automatic mode into two separate output windows: a so-called „Control Panel“ and a „Process View“ (which is displayed optionally).

The keyboard-oriented Control Panel is the central operating element and is displayed permanently. Commands are entered using the function keys or a menu. The control panel provides a compact and rapid visualization of the inspection process.

Customers wishing for a detailed visualization can display a second, optional window called Process View.

The arrangement and display of the two cooperating windows can be configured at will. For example, the Control Panel can disappear „behind“ the Process View window after a certain amount of time to use the maximum available screen area to visualize the inspection process.

Solution: Graphical Development Tools

For the applications engineer to be able to set all the parameters and settings without any programming knowledge, NeuroCheck offers a specially developed graphical interactive design tool (the so-called „Designer“) for the Control Panel and Process View integrated into the software.

The Designers enable you to design a window interface interactively from a number of pre-designed output windows (Controls) using Drag&Drop. Graphically

Even exceptional user interface designs are feasible

attractive controls are available for the visualization of

- evaluation results for the current inspection piece,
- intermediate results in the form of images or lists of values,
- status, diagnosis and result messages of the system,
- I/O states,
- statistical information and measurement data series,
- target values of the peripheral equipment,
- …

Buttons for commands and the selection of menus can be added interactively as well. What command is assigned to one of the 12 function keys on a typical PC keyboard, is up to the user. A high degree of operating security at the line is achieved by links to password-protected user profiles.

In the future, system integrators, machine builders and end users using the NeuroCheck platform can fully realize their corporate design.

Hundreds of freely configurable color, font and style settings for the controls allow for the implementation of individual designs of the user interface. It is also possible to adapt to the operating philosophy of a PLC manufacturer already familiar in the company, thus reducing the amount of training for the operating personnel.

All user interface designs and menus are saved as XML files and can be transferred between computers.

Also available is a large number of attractive, pre-defined designs for various screen resolutions and applications that come with the software and can be selected with a mouse click.

Conclusion

Due to the new approach and the software tools available, user interfaces optimized for any kind of machine vision application can be easily designed. According to the customer‘s needs, a customized and safe-to-use system can be quickly delivered. In the end, efficient production is the aim of every customer, a proven operating concept is a vital contribution.

Reference

[1] Cover Story „Modernes User-Interface garantiert hohe Nutzerfreundlichkeit“ by Christian Demant, NeuroCheck GmbH, in INSPECT 2/2008.

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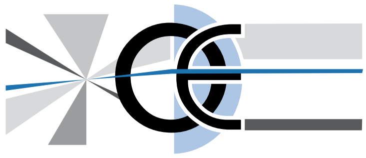
TELECENTRIC LENSES



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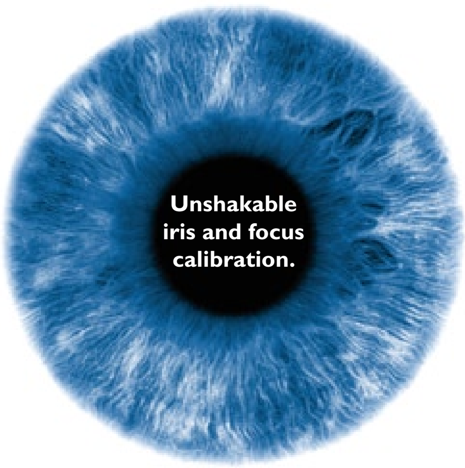

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Well-lit

Correct Lighting Increases Reliable Detection in Industrial Automation

Vision sensors used in industrial automation demand a great deal of lighting. Both the choice of lighting and how the sensor and light source are positioned in relation to each other are decisive features to ensure reliable detection. Dependant on the application there are different choices for the best illumination set-up.

Vision sensors have conquered numerous applications in industrial automation over the past few years. The most important fields today include part detection using sample and contour detection, color detection as well as the identification of bar codes and data matrix codes. However vision sensors demand a great deal of the lighting source: the better the image quality, the greater the detection reliability. Correct lighting is essential for the success and stable, reliable functioning of each automation application with vision sensors.

Bright or Dark Field Lighting

Basically there are two main types of lighting: bright field and dark field lighting. In bright field lighting, the sensor and lighting system are aligned in a way that light is reflected from the surface directly into the sensor. On the contrary in dark field lighting, the light source and sensor are positioned to ensure that only diffuse light, e.g. from edges, arrives directly the sensor.

Bright field lighting with vertical alignment of the sensor in relation to the object can cause problems due to reflections – even with a black plastic surface, see figure 2 – as it over-illuminates the white sample to be detected. Instead it is advisable to tip the sensor with its integrated lighting slightly in relation to the surface of the object (e.g. 10–20°). This avoids direct reflections from the background so that it appears dark and the white imprint, with a diffuse reflection, is simultaneously accentuated. The result is a stable, high-contrast image.

Fig. 1: Vision sensor with integrated LED lighting

Bright field lighting is not recommended either for plastic parts with embossed extruded features such as markings for example, due to reflections. Dark field alignment with a sensor at a tilted angle to the object's surface provides better results; however the optimum solution in this case is frontal alignment of the sensor with flat incidental, lateral light from an external light source, shown in figure 3.

Also bright field lighting has advantages, e.g. by detecting strongly reflective metal surfaces (fig. 4). Even from a white background the total reflection accents the metal surfaces, so a high level of detection reliability is achieved. When using bright field lighting the image quality depends strongly on the surface and angle of alignment, so the stability of these factors must be observed in the series production.

Special Lighting Situations

Special applications need special solutions. Detecting a symmetrical round part, dark field alignment with an external ring light is recommended. With it the contour of a toothed wheel, e.g., becomes clearly visible without undesirable shadows. Different object details can be highlighted according to the angle of incidence of light adjusted by varying the lighting distance.

To detect markings on cylindrical, strongly reflective metal parts, the use of diffuse dome or tunnel lighting is indispensable. This is also valid for randomly and dispersively formed – and thus randomly and dispersively reflective – series of plastic film and aluminum foil, as used for medicine blister packs and other packaging. With this type, light is not directed, but penetrates evenly from all directions, like on a cloudy day.

With transmitted light, the outer contours or profile of a part are particularly accentuated. Structures presented on the part itself are on the other hand not visible with this configuration. However, transmitted light is problematic to install in many cases.

Transparent Objects

When detecting embossed or recessed structures on transparent objects – such as a laser-etched data matrix code in a glass panel – the problem of double contours can arise due to reflections from the front and rear. Therefore the sensor should be positioned vertically to the surface whilst external light shines from the side. For this purpose either a surface light or ring light can be used.

Intensity of Lighting

Intensity of lighting can be adapted with almost all vision sensors indirectly via the exposure time (shutter opening time) and sensor gain. Short shutter times, which mean very bright light, should generally be aimed at, so that fluctuations in ambient light have only little effect on the function of the application. With moving parts, short exposure times (e.g. through a flash light) eliminate movement blurs caused by too long exposure. In order to avoid a flurry of flashes in installations where people are also working, the use of non-visible infrared lighting is advisable.

Colored Lighting

By using colored lighting or color filters, it is possible to accentuate part features or render them “invisible“. For example, a black marking appears with maximum contrast on a red plastic surface when a monochrome sensor with red lighting is used, as the red background reflects a large amount of light and thus appears very bright whilst the black marking hardly reflects at all. However, if green

Fig. 5: Use of a ring light enables the accentuation of outer contour

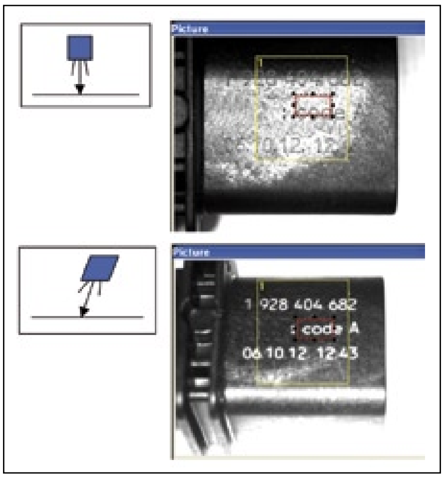

Fig. 2: With bright field lighting reflections can even occur on black plastic surfaces. Preference is therefore generally given to dark field lighting (below)

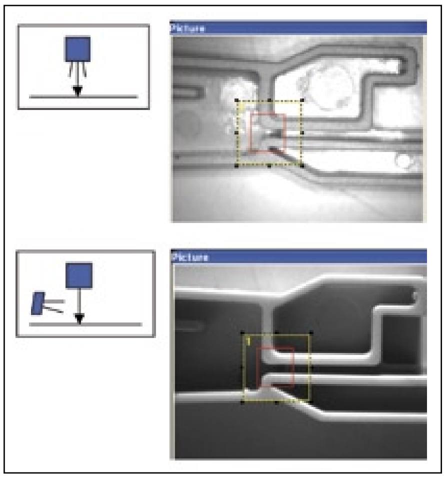

Fig. 3: Dark field alignment with lateral grazing incidence is recommended for embossed structures (below)

lighting is used on the same part, the contrast between the red background and black marking virtually disappears as the red plastic background reflects almost none of the complementary color green and the black marking no longer stands out from the background which now also appears as almost black. The “black marking” characteristic is thus blanked out using this method.

By combining red lighting with a red light band pass filter fitted in front of the sensor, interfering effects of ambient light can be largely blanked out to avoid shadowing the application.

Conclusion

The majority of applications can be solved with bright field or dark field lighting using the lighting source integrated in the vision sensor. Different positions of the sensor in relation to the object should thus first be tested.

Dark field lighting allows to accentuate edges on contoured objects (e.g. structures which are embossed or recessed in relation to the object surface). This works reliably over entire part series as these edges vary less over the entire series than the surface which can often range from very shiny to oil-smeared or corroded.

By using bright field lighting, the shine from very reflective component surfaces can be used for its high-contrast accentuation. It must be ensured that the object is shiny throughout the entire production series and that the angle of alignment to the part surface is easily reproducible.

Due to its reliable function and low angular dependence dark field lighting is preferable wherever possible.

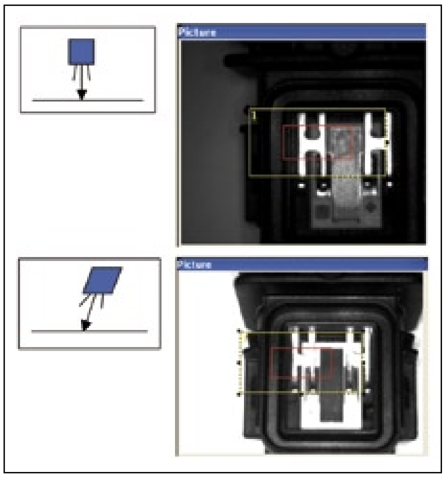

Fig. 4: When detecting reflective surfaces, bright field lighting (above) generally delivers the best results

If a satisfactory result cannot be achieved with the integrated lighting, it is recommended to disassociate the direction of detection and lighting by using an external light source. Surface lights, ring lights and transmitted light are available as alternatives with a white, red or infrared light source. By varying the measurement distance, angle of detection and lighting angle, a suitable solution can be found for almost every measurement task. However, the choice of the correct lighting depends strongly on the application and requires individual examination.

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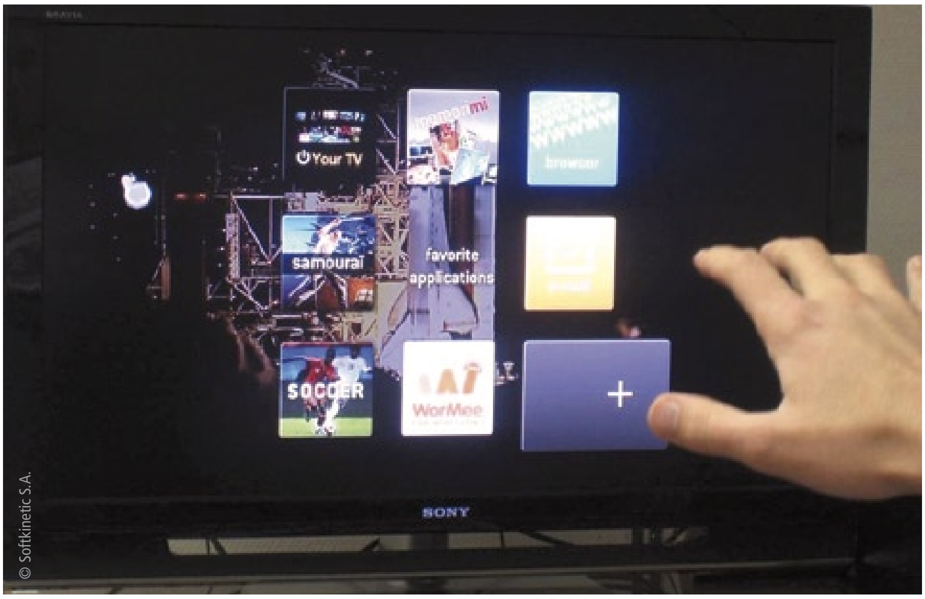
Minority Report

Futuristic Interface Technologies by 3D Vision

Remember the great scenes in the movie when Tom Cruise like a magician manipulated data and documents over a huge transparent screen by nothing more but moving his hands? PMD technology based on time-of-flight with the Photonic Mixer Device (PMD) enables exactly that by efficient and inexpensive 3D image capture at high speed. In the last years, the technology has made enormous progress.



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When developing new camera and sensor systems, the creator of the technology, PMDTechnologies, cooperates with outstanding experts in their respective markets as well as experienced partners and camera manufacturers. This results in measuring systems that are perfectly tailored for the customer's needs in terms of accuracy, resolution, cost and robustness.

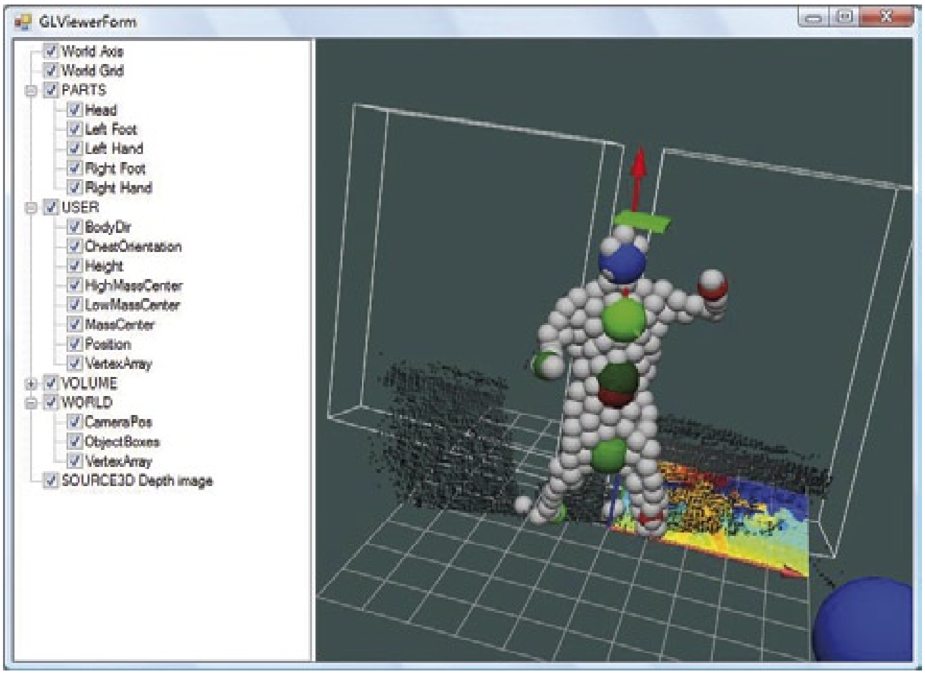
PMD cameras use the time of flight principle. Every camera is equipped with at least one light source which illuminates the scene. Typically, infrared light is used; invisible to the human eye. Alternatively, other (visible) light sources are possible and, depending on the application, sensible. The distance measurement is done by measuring the time that the emitted light takes to travel from the light source to the object and back to the PMD receiver inside the camera. If this time of flight is known, it is very easy to calculate the distance using the known and constant speed of light. A significant advantage of PMD technology is the ability to not only capture both the entire scene in 3D and in a traditional grayscale image at the same time, but to also deliver the signal strength for each pixel. With the signal strength it is easy to determine the quality of the measurement for every distance value. The pixel integrated SBI circuit (SBI – Suppression of Background Illumination) of state of the art PMD sensors achieves an outdoor capability that creates reliable results even on sunny days. A more detailed description of the PMD principle was published in INSPECT 1/2008.

World Record Resolution in a Modular Design

Currently, there are several PMD cameras available for a diverse range of application areas. The latest model is the PMD[vision] CamCube, an evaluation platform, which is – with its modular concept – designed for highest flexibility. With its high resolution and its functional diversity it is suitable for a wide range of applications. The PMD chip inside the CamCube is based on the cutting edge of PMD technology and contains more than 41,000 ToF pixels (204 x 204) – more than any other time of flight 3D camera on the market. With the integrated SBI circuit, this camera also has a high resistance to background light. The USB 2.0 interface provides frame rates of up to 25 frames per second. The standard PMD[vision] CamCube model has an unambiguous range of 7.5 m. This range can be significantly extended through appropriate measures. A fundamental advantage for the evaluation of PMD technology is the modularity of the CamCube. It is easy to change the CS-mount lens and therefore adapt the field of view and light intensity to the customer's needs. Secondly, the light sources, which are contained in separate housings, can be replaced. Through customized light sources it is possible to extend the range and accuracy of the camera, reduce the power consumption or heat dissipation or mount the light sources in a different location than the camera module. The latter is, for example, needed in the automotive sector, where the light sources are usually mounted in the head lights, whereas the camera module is placed behind the windshield above the rear view mirror. This unique diversity is also especially useful for industrial applications. Its flexibility makes the PMD[vision] CamCube suitable for a wide range of applications. For example:

- robot control,
- bin picking,

The PMD[vision] CamCube: Distance measurement with more than 41,000 pixels



Body recognition with Softkinetic's iisu (picture courtesy Softkinetic S.A.)

- virtual and augmented reality applications,
- area inspection,
- man machine interaction (see below).

Small Gestures with a High Impact

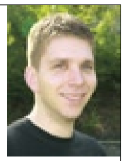
An interesting application for the PMD[vision] CamCube comes from the Belgian company Softkinetic S.A. Softkinetic develops and markets software for gesture recognition and body pose estimation for end-user applications. Softkinetic's iisu ("Interface Is You") serves as a middleware between 3D cameras and application software and is able to capture the human body and recognize the position and orientation of the head, the body, the arms and legs. This makes it possible to control applications only through your own movements – without the need for additional input devices like a keyboard or a mouse. For the games industry, this is the consistent continuation of established input methods like Sony's Eye-Toy or Nintendo's Wii and provides the player with a new quality of immersion into the game world. The player does not indirectly control an avatar anymore but becomes an active part of the virtual world himself. He can observe this world, move around in it and interact with objects like he does in the real world.

But also other sectors benefit from this technology. The health sector can use the body capturing in rehabilitation exercises. The fitness industry also has the potential for interesting applications. The ability to recognize gestures can replace or augment the often unclear and complicated remote controls for TV sets and other consumer electronics devices and provide much more extensive and intuitive functions. In many areas of industrial applications, those interactive man-machine capabilities might also be very interesting in the future, delivering innovative solutions.

The PMD[vision] CamCube is – with its currently unequalled resolution and performance – ideally suited for iisu. Its high resolution achieves the precision that is required for exact gesture and body recognition. PMDTec and Softkinetic make it possible for software and hardware manufacturers to create innovative and intuitive user interfaces.

In the future, even more technological progress is expected. In terms of resolution, dynamics, speed, background light resistance and accuracy, a lot will happen in the coming years. Exciting things to look out for.

▶ **Author**
Martin Profittlich, Manager Software Development Group



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LED High-power Light Source

Eltrotec Sensor presents the second range of "LEDControl 160" LED light sources. Model no. 1 at 3.5 MLux now accompanies its 10 MLux "big brother", which is now available and is to serve as an alternative to halogen light sources used in the areas of microscopes, endoscopes, forensics, sensors, image processing, installation engineering as well as in clean room technology, medical technology and pharmaceutical technology. An extremely white light is emitted at a color temperature of 5600°K, which clearly distinguishes itself from that of halogen lamps at approx. 3000°K. LEDControl 160 gains it high level of luminosity, now at 10 MLux at an overall power consumption of only 25 W, from a specially connected high power LED system which is connected to the respective fiber optic cable by means of various reduction glass cones with an optical outlet of 12 mm.

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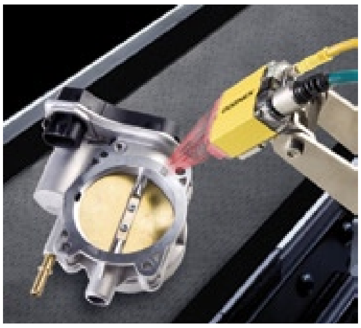
Ethernet Connectivity and Liquid Lens Technology



Cognex has announced the newest addition to its DataMan family of ID readers. The new DataMan 200 adds Ethernet connectivity and liquid lens technology to the world's smallest high performance fixed-mount reader. These new features enable faster communication speed, easier integration with factory controls, and software-driven autofocus for easy, hands-free setup. "The DataMan 200 combines the powerful reading performance and ultra-small size of the DataMan 100 with engineering innovations that improve connectivity, speed and ease of use," said Carl Gerst, senior director of ID Products. "The system is the first image-based reader to feature full Ethernet connectivity in a package the size of a matchbox. It is also the first to offer liquid lens technology, which makes it ideal for applications that have variable focus requirements."

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Enhanced 3D Quality Control

3D point cloud acquisition and processing libraries developer Aqsense developed a flexible 3D imaging library that has delivered excellent results in industrial applications. The technical approach is that of capturing 3D Point Clouds (COPs) from laser triangulation or any other digitizing source delivering organized COPs. The following processing with the tools contained in SAL3D (The 3D Shape Analysis Library) merges the data from multi-camera layouts to avoid occlusions, obtains true metric measurements in every of the three axis XYZ, and compares whole data sets corresponding with a 'golden model' with the scanned data. The alignment is based on mathematical algorithms, so no fixtures are needed for positioning the scanned part, and comparisons can be performed in fractions of a second.

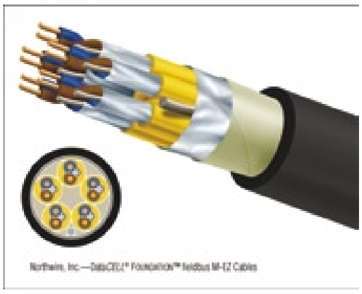
Aqsense S.L.
Tel.: +34 972 183 215 • info@aqsense.com • www.aqsense.com

Compact Fixed Focal Length Lenses

Edmund Optics introduces Techspec compact fixed focal length lenses. Designed for use in machine vision applications, the lenses are ideally suited for factory automation, inspection or qualification. The lenses have been optically designed with the specific working distance and unique resolution requirements of factory automation and inspection in mind. These high performance lenses feature large maximum apertures, so they can be used in even the most restrictive lighting conditions. Each lens includes a broadband anti-reflection coating, which increases transmission by up to 12% over standard MgF2 coatings on competitive lenses. They are available in focal lengths of 8.5 mm, 12 mm, 16 mm, 25 mm and 35 mm and support up to 2/3 inch sensors.

Edmund Optics Inc.
Tel.: +1 800 363 1992 • medmund@edmundoptics.com • www.edmundoptics.com

Easier and Faster Wiring of Marshaling Cabinets



Northwire has increased its DataCell Field line of products to include multi-pair Foundation fieldbus M-EZ (Marshaling EZ) cables. The cables are engineered with up to 24 individually foil-shielded pairs with an extruded PVC binder over each pair, all contained within a single cable. DataCell Foundation fieldbus M-EZ allows for fast, simple installation into marshaling cabinets and requires no shrink tubing. All cables are among the first to be FF-844 certified by the Fieldbus Foundation. This certification assures that the cable is electrically precise and meets Foundation fieldbus type A cable physical property requirements. Northwire has provided Foundation fieldbus cable for rugged petrochemical and other plant environments with networked process automation and control for over 10 years.

Northwire Inc.
Tel.: +1 715 294 2121 • cableInfo@northwire.com • www.northwire.com

New Color Cameras

Dalsa announced the addition of the Falcon 4M60 and 4M30 Color CMOS cameras to its family of Falcon global shutter cameras. Capable of running at 60 fps with 4 megapixel resolution, the Falcon 4M60 color is today's choice for leading edge color applications in electronics inspection, semiconductor inspection, and imaging markets. The implementation of color imaging makes it even easier to find defects in these demanding inspection applications. The Falcon 4M60 and 4M30 cameras use Dalsa's patented CMOS sensor technology with global shuttering to eliminate imaging issues, such as smearing or time displacement artifacts, often associated with full frame, frame transfer, or rolling shutter cameras. In addition, features such as individual color gain and offset allow for white balancing of the image and make this camera easy to use.

Dalsa
Tel.: +1 514 333 1301 • sales.europe@dalsa.com • www.dalsa.com

Maximum Camera Performance in Minimum Housing

Mikrotron's new, extremely small and light sensitive High Speed recording camera, MotionBlitz EoSens mini offers with its outstanding performance new and up to now unreachable possibilities of application. With its size of only 63 x 63 x 64,5 mm (HxWxD) and integrated GigE Vision and Genicam compatible interface it is unique in its class and offers a maximum of flexibility, mobility and ease of use. The housing is available with connectors on the rear or on the left side of the housing. This reduces further the length of the camera. The extremely high light sensitivity of 2500 ASA monochrome und 2000 ASA color helps saving extra money for lighting by minimizing the investment in extra light sources. The build in FPN correction on a pixel by pixel base corrects for black level and dynamic deviation.

Mikrotron GmbH
Tel. +49 89 726342 00 • info@mikrotron.de • www.mikrotron.de

CMOS Camera

The Lumenera Lm085 mini CMOS USB 2.0 camera is designed for industrial environments with high contrast-light scenes, tight space constraints, and rugged environmental conditions. An ultra-wide dynamic range makes the Lm085 an ideal choice for applications with variable lighting conditions, as this camera can provide a dynamic range of 100dB. The Lm085's small form factor of 44 x 44 x 56 mm and robust mechanicals are well suited for conditions where the camera is under sustained vibration, fatigue, and stress from conveyor lines, mechanical arms, mobile vehicles, or gantries that introduce shock and vibration. An electronic global shutter eliminates the smear effect generated by moving objects, while the locking mini USB and RJ45 GPI/O connectors keep cables reliably attached to the camera back plate even in challenging conditions.

Framos GmbH
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www.svs-vistek.de

Avoid Confusion about NFPA-79

Confusion abounds about the "new" National Fire Protection Association (NFPA) regulations pertaining to UL-recognized (AWM style) cable. Long after the practice became widespread, inspectors became aware of the ubiquitous use of AWM (Appliance Wiring Material) style cables in machine interconnecting sensors, actuators, switches and other components – often as part of premolded connector assemblies. The 2007 change to the NFPA-79 electrical code states that AWM-style single-conductor wire or multi-conductor cable is not permitted on machinery unless it is part of a UL-listed assembly. In other words, machine wiring requires UL-listed cable. Clearly, UL-listed cable has been available for many years. So the real question is which UL listing is appropriate for particular applications? Herein lies the confusion – speculating about the intent of the code change. Contact Northwire for information and samples.

Northwire, Inc.
Tel.: +1 715 294 2121 • cableinfo@northwire.com • www.northwire.com/nfpa

Frame Grabber Supporting 64-bit Addressing

Adlink has announced the release of the PCIe-CPL64, supporting the power over camera link (PoCL) standard. The PCIe-CPL64 is specifically designed for cost-sensitive computer vision applications by providing two base configuration channels with data transfer rates up to 4.0 Gb/s and pixel clock rates up to 85 MHz. The PoCL feature reduces costs by reducing wiring as external power adapters would not be necessary. The PCIe-CPL64 can also support non-PoCL cameras automatically through SafePower function which is designed for backwards compatibility with non-PoCL cameras. By supporting the extended memory space of 64-bit operating system such as the 64-bit editions of Microsoft Windows XP and Microsoft Vista, the PCIe-CPL64 is well-suited for large address space vision applications such as flat panel display, LCD, and solar cell surface inspections.

Adlink Technology Inc.
Tel.: +49 211 4955552 • emea@adlinktech.com • www.adlinktech.com

New Color Vision Systems

Cognex announced three new color vision systems for the In-Sight Micro product line. Building on last year's highly successful introduction of the world's smallest vision system, the In-Sight Micro, this new release provides a complete suite of color models within this product family. The entry level In-Sight Micro 1100C model provides a highly capable, standard (640 x 480) resolution color vision system at a competitive price. The high performance In-Sight 1400C model doubles the processor performance for more demanding applications. And, the new In-Sight 1403C model is a two megapixel (1,600 x 1,200 resolution) system that enables high resolution inspection for a wide variety of color applications. In addition to the new color vision systems, Cognex is announcing the release of In-Sight Explorer version 4.3 software. This release introduces two powerful new color tools to the industry-leading library of vision tools.

Cognex Germany
Tel.: +49 721 66 39 252 • info@cognex.de • www.cognex.com

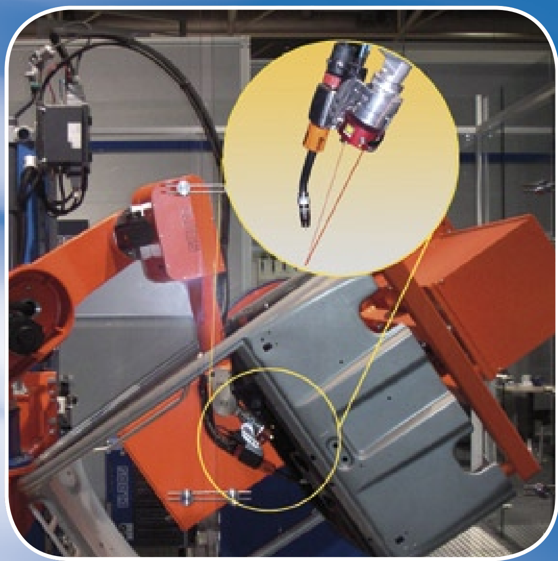
Product Lines Unite

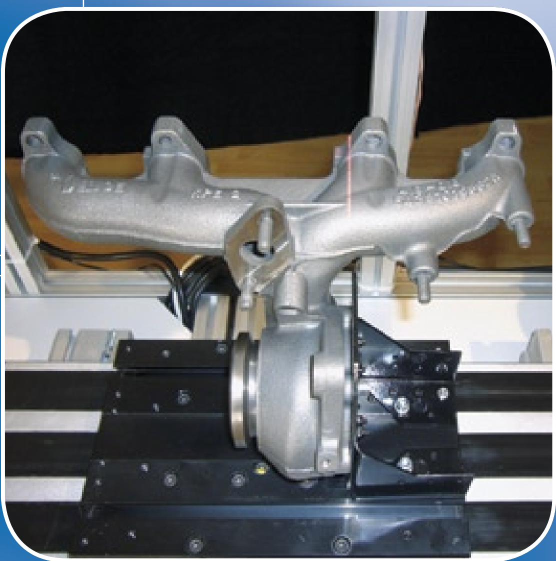
Gardasoft Vision have announced that they have signed the worldwide rights to the VCubed ultrahigh brightness LED linelight and traffic monitoring lights. The world-leading liquid-cooled VLX2 Linelights are many times brighter than conventional air cooled LED linelights. They are used in linescan applications such as printing, paper, plastic film or web inspection up to 4 m wide. The limiting factor in many systems is the speed of the inspection system. With these lights the whole system can run much faster. Manufacturers will be able to reduce costs and increase efficiency, often by running fewer production lines but faster. OEMs will be able to increase the sales value of their systems and system integrators will be able to achieve higher performance and reduce the Return on Investment time.

Gardasoft Vision Ltd.
Tel.: +44 1954 200 343 • vision@gardasoft.com • www.gardasoft.com

INSPECT

Automation





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.

In the Mold

3D Quality Inspection of Cast Parts

Within every manufacturing process it is very important for smooth production flow and high yield at equally high quality level to detect any faulty parts as soon as possible. Only then it is possible to avoid rework in the production process and resulting loss of production time and thus keep productivity high.

3D camera from Photonfocus MV-D1024E-3D01-160-CL

Within the automotive industry one of the typical manufacturing processes is the assembly of complex cast parts, e.g. turbocharger, engine block or brake bodies. It is not unusual for cast parts delivered from a foundry directly to the factory floor to include different kinds of defects in the casting, e.g. blowholes, bumps, excess of material.

Today the detection of any major defects on the cast part is typically left to a random visual inspection. This visual inspection obviously increases the risk of not finding all defects on the cast part. This again increases the probability that, further down the assembly process, the individual components need to be disassembled in a time consuming process, thus reducing the productivity of the manufacturing process.

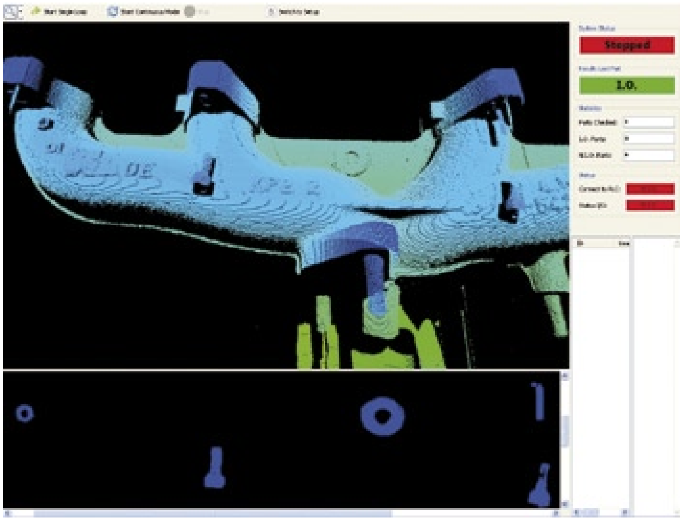
3D Quality Control of Cast Parts

The goal of a joint project between the machine vision companies Photonfocus AG from Switzerland, Aqsense SL from Spain and ACT Smartware GmbH, Germany was to deliver an automatic inspection system capable of checking all incoming parts of one complex cast part at the start of the assembly process. The complete inspection system consists of 3D cameras from Photonfocus and the easy to use operating software 3D Vision Factory from ACT Smartware, which relies on the specialized 3D software libraries from Aqsense.

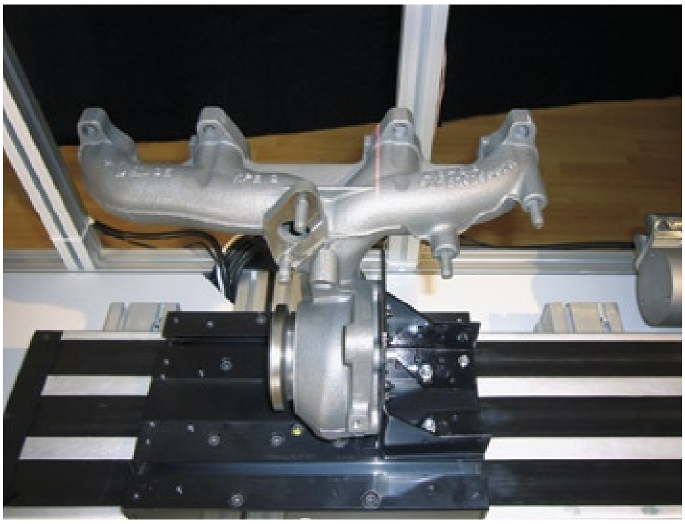
The new inspection system has already been able to cut down on disassembly times related to defects in the cast parts and has thus been able to increase productivity time.

The flexible 3D inspection application designed by ACT Smartware allows a fast system setup, which can be installed on an existing production line which moves the casting part on a conveyor belt or linear stage underneath a system of 3D cameras from Photonfocus and a laser. In order to minimize occlusions (shadows cast by the part upon itself) the system uses two 3D cameras.

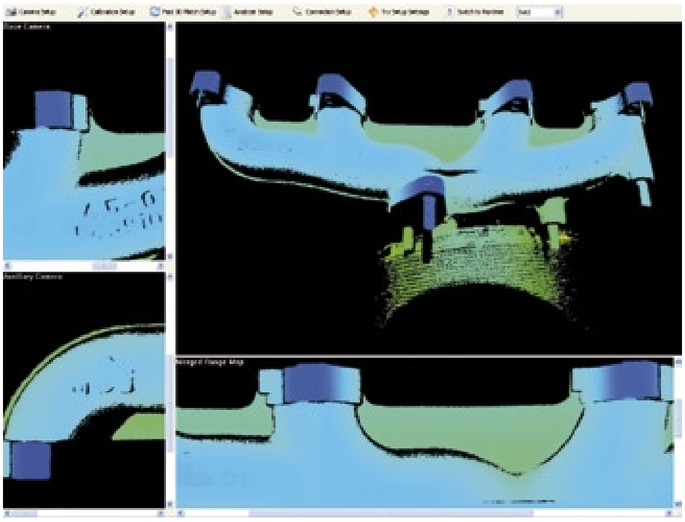
The 3D software tools delivered by Aqsense enable a metric calibration and merger of images from both 3D cameras into a single calibrated 3D image. In the next step, the 3D Vision Factory software accesses the 3D matching library in order to compare the 3D scan of the cast part with a reference model stored on the computer. Analyzing the resulting 3D image for deviations enables the system



Runtime mode: The operator can monitor all important information such as 3D scan, image analyzer, ok/nok decision and statistical data in one view



3D Quality Control of cast part



Setup mode: In the setup view the merged 3D view of two 3D cameras is shown, the 3D view can be interactively manipulated and all necessary parameters for the runtime mode can be set

to make a decision on whether the scanned cast part is ok or not ok. A complete 3D scan, analysis and decision making can be carried out in around a second. This enables the inspection system to be used for a 100% 3D inline inspection of complex castings, rather than only relying on an offline statistical quality control. The decision taken by the 3D Vision Factory is finally transmitted to an existing control system (e.g. a PLC) in order to physically move on or stop the cast part on the conveyor belt or linear stage.

The precision of the inspection system obviously depends on all the vision and mechanical components used, but can be as precise as a few micrometers.

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ACT Smartware GmbH,
Karlsruhe, Germany
www.act-smartware.de

Aqsense SL, Girona, Spain
www.aqsense.com

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Yield Increase and Quality Improvement in Robot Welding by Usage of Laser Vision Systems

The biggest cause of underperforming arc welding robots is the variability in the joint location. Traditionally the most common method used to correct for this variability is to use the weld wire, torch nozzle or separate probe to search for the joint and send the correction values to the robot to offset the pre-programmed path. Although this method can work in some situations, it can never achieve full optimization because it is very slow and inaccurate. In addition, on materials like aluminum or coated steel it is totally ineffective. Laser vision sensing is five times faster and also five times more accurate which can dramatically reduce non added value search time while improving finished weld quality immensely.

The seam finding technique is basically the same no matter which robot type is integrated to the laser vision sensor system. The seam finder can either employ a spot or line laser, depending on the exact application requirements.

High Speed with Laser Spot Sensor

The spot laser vision sensor shown in figure 1 is integrated very easily to any robot. The unique robot faceplate mounting allows the laser to reach any place the weld wire can, thus providing maximum access and flexibility. Just like with touch sensing, the robot is moved across the joint to locate and measure it. However unlike when the weld wire is used, the laser can be moved extremely fast which drastically reduces cycle time wasted. All standard robot programming deployed when doing touch sensing can be used with laser sensing thus simplifying doing a retrofit.

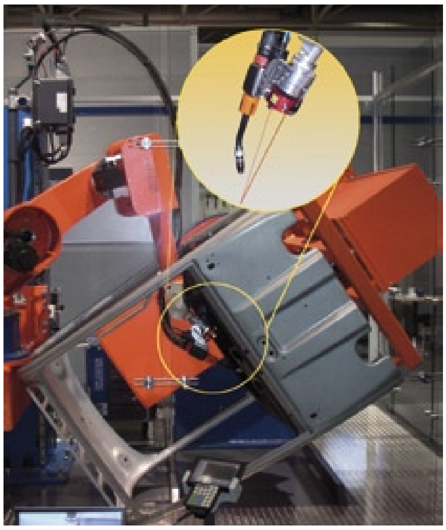

Fig. 1: Laser spot vision sensor seam finding on enclosure with close up of the sensor system mounted to the robot (Picture courtesy of Carl Cloos Schweisstechnik GmbH)

Long Standoff with Laser Line Sensor

The laser line sensor is typically mounted as shown in figure 2. This system uses a laser line with a field of view of about 40 mm (width) x 100 mm (depth) and a

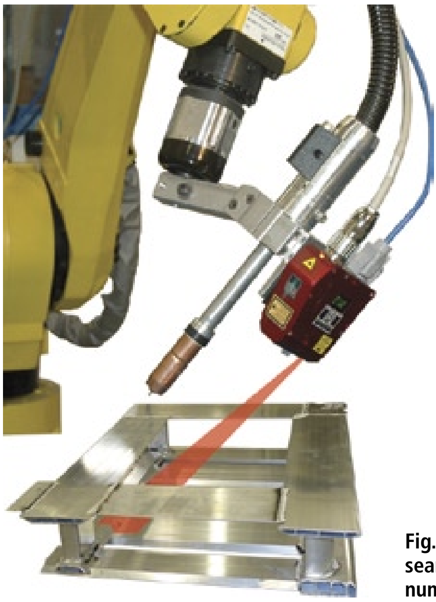

Fig. 2: Laser line sensor seam finding on aluminum pallet

resolution of 50 microns. In addition it has a long standoff which allows one to mount the camera far from the welding arc if necessary so any tooling around the part can be avoided. These capabilities mean that any joint (tight butt, thin sheet lap fillet, groove, etc) that is within the field of view of the laser sensor can be located in less than 0.5 seconds. In addition, joint features like gap, area and mismatch can be measured and the values used to either prevent welding from starting if they are out of specification, or alternatively selecting a different weld schedule to handle the changed condition. This combination of precise electrode location with respect to the joint and the ability to adapt the welding parameters to the actual joint condition maximizes productivity (faster travel speed) and quality. See figure 4 which explains further the sequence of seam finding from start to finish.

Increase of Productivity and Quality

An excellent example of an application that benefited tremendously from the use of laser vision seam finding is the manufacturing of farm tiller components. These are produced in a robotic Gas Metal Arc Welding cell with a total of about 60 welds per part having an average length of 35 mm.

The productivity and quality levels were reasonable, but in the new economic envi-

Fig. 3: On a farm tiller welded component, a total of about 60 welds per part having an average length of 35 mm, are done in a robotic gas metal arc welding cell

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realize visions.

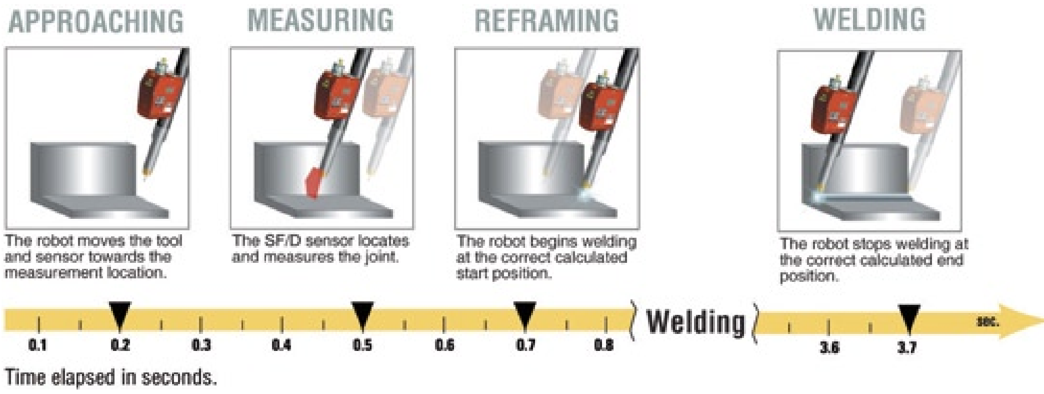

Fig. 4: Sequence from start to finish for seam find and weld cycle

ronment this company finds itself in, more parts per hour and reduced repair rates are required from every piece of equipment they operate. The biggest place to improve in this particular robotic welding station was to reduce the time spent doing seam finding which totaled about 4.2 minutes. The touch sensing was used to try to handle the stack-up of part and fixture variability. The reason the touch sensing took so long was that the sequence required first finding the bottom of the Tee joint and then going over to find the upper part of the joint. This search routine was done at a very slow rate of 0.2 m/min because at any faster speed the search would be very inaccurate due to overshoot and wire bending. In addition, due to distortion concerns, the part was welded in sections. This meant that after touch sensing the robot would weld a section of the tiller component. Then the robot would have to move over to the wire cutter to cut it off so that the wire end was sharp to improve touch sensing performance. This extra operation wasted even more time.

With the laser line sensor, this 4.2 minutes of searching was reduced by 2/3 which resulted in a big time saving. In addition, the laser searching was much more precise which allowed the travel speed to be increased 20 % and the reject rate reduced 10 %. All these improvements added together resulted in the ability to produce 70 more parts per week from the same robot cell. The payback on the installed laser vision system was less than six months.

Conclusion

Every company in the world needs to deal with the new economic reality requiring greater efficiencies from every piece of equipment and every person on the production floor. It is a reality that in welded components there will many times be excessive variability in the detailed parts making up the assembly and in the fixturing used to put the assembly together. For this reason, some type of sensor must be added to the arc welding robot to allow it to accommodate for this variation, either batch to batch or even part to part. Laser vision sensing, both seam finding as discussed in this paper, and real time seam tracking with adaptive control which is used for longer welds, must be employed to achieve optimized welding. This optimization will achieve maximum productivity and quality, while also helping companies become less wasteful and thus greener.

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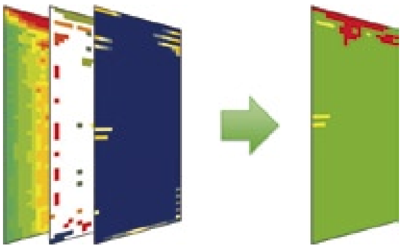
More than a Brochure

Aerotech has released a new 72-page brochure that highlights its complete range of high performance motion and machine controls, software, drives, and motor technologies. The Automation Control Solutions brochure uses an uncomplicated presentation style with actual screen shots, simple graphics, bullet points and application examples that combine to demonstrate how its advanced controls, software tools and highly-developed product lines can provide real and measurable benefits such as faster production throughput, reduced development timescales and significantly improved final product quality. The new brochure compares the significant features of its three motion and machine controller lines – the PC based Automation A3200 for multi axis motion and machine control; the stand-alone single axis Soloist; and the stand-alone multi axis Ensemble range. Each benefits from a scalable and common software platform which makes configuration, set-up, diagnostics, program development and data acquisition straightforward.

Aerotech LTD
Tel.: +44 118 940 9400 • aerotech@aerotech.com • www.aerotech.com

Dynamic Quality Assurance



The first products offered by recently established QuinLogic have passed their field tests. The QualityMonitor and LogicDesigner solutions from QuinLogic make quality grading in steel and aluminum strip production more objective. They increase production efficiency and optimize material use. Furthermore, the software supports strategies for the use of alternative process routes in order to achieve optimized utilization of the production units. The first customers have used the software to develop new ship/block rules for pickling lines, which now no longer depend on the subjective judgment by inspection personnel but use data from several inspection systems. They will soon be using the QualityMonitor solution to assess the strip meter by meter, enabling optimized use of the individual strip sections.

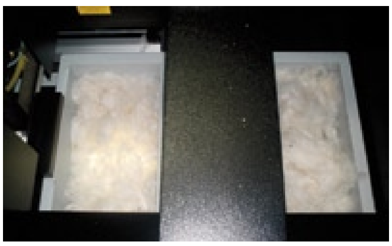
QuinLogic GmbH
Tel.: +49 2405 479994 0 • info@quinlogic.de • www.quinlogic.de

Vision Inspection Solution

PPT Vision announces their Sentinel Mold Protection Solution is now available internationally. The Sentinel offers the manufacturing industry a superior turn-key vision inspection solution to protect mold processes and tooling by detecting errors in real-time, then shutting down production and alerting operators before damages occur. Initially released in the United States in November 2008, the superior protection capabilities can now be utilized in molding applications worldwide. The Mold Protection Solution was unveiled in early April to the global molding industry at the Southern China Plastics and Mold Show in Shenzhen, China. It supports up to four cameras. Each camera provides users the ability to configure up to five mold inspection stages, including the inspection of mold flash, short shot, part ejection, pin retraction, insert position verification and more.

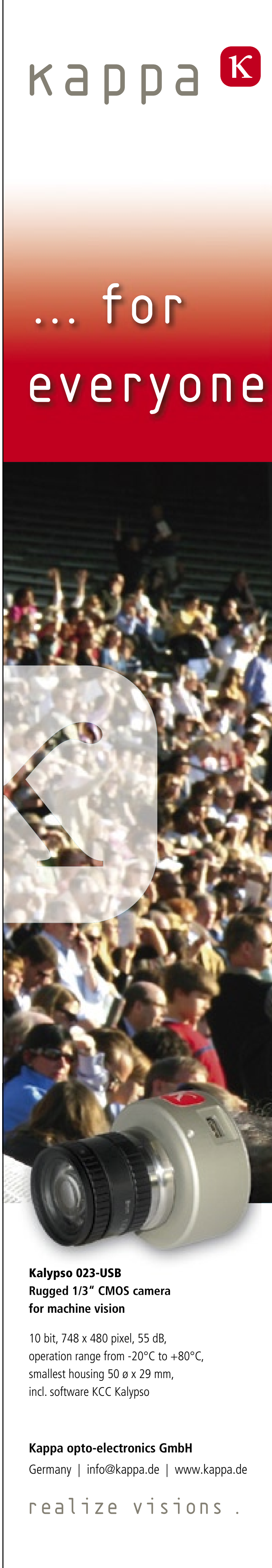
PPT Vision, Inc.
Tel.: +1 952 996 9500 • info@pptvision.com • www.pptvision.com

Cotton Interlaced



Premier Evolvics, a leading Indian manufacturer of quality testing and online monitoring equipment for the textile industry, recently upgraded their ART fiber testing machines with digital cameras from Allied Vision Technologies. Previously, the camera used was an analog CCD camera with interlaced scan combined with a frame grabber and a licensed image processing system. An alternative solution was offered to Premier Evolvics by Lucid Imaging, a leading supplier of machine vision solutions in the Indian market and Allied Vision Technologies' distribution partner in India. The package included the migration from an analog to a digital interface and the replacement of the licensed image processing software with an open-source based application. This was made possible by the unique Guppy digital cameras with interlaced sensors from Allied Vision Technologies.

Allied Vision Technologies Inc.
Tel:. +1 978 225 2030 • info@alliedvisiontec.com • www.goavt.com • www.alliedvisiontec.com



Improved Measuring Accuracy of up to 50 µm

Nowadays, the production of tubes is shaped by narrowing tolerances. Aicon reacts to this demand and launches the new camera-based 3D tube measuring system TubeInspect HS. For measuring the tubes, TubeInspect HS uses 10 digital cameras with higher resolution. Moreover a spatial reference point field made from glass, being especially stable with respect to shape and temperature, is located in the measuring cell. Thus the measuring system can resort to reference points in different spatial planes, which leads to a more precise measurement of the tube geometries. Also in terms of the software, basic changes have been implemented. TubeInspect HS makes use of Aicon's new software version 4.5 that contributes to a higher measuring accuracy thanks to an improved algorithm.

Aicon 3D Systems GmbH
Tel.: +49 531 58 000 58 • info@aicon.de • www.aicon.de

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Laser Tracker Based Robotic Measuring Systems

The Leica Absolute Tracker can now be used in fully automated measuring systems. Measurement processes are from now on more time and cost efficient than ever before. The process accuracy is no longer limited by the positioning device. The unparalleled accuracies of the 6DoF Leica Absolute Tracker can now be applied to any robotic positioning system turning it from an ordinary robot into an incredibly accurate metrology device. With a Leica T-Scan mounted on a robot or a Leica T-Mac equipped with a tactile or optical probe, the Leica Absolute Tracker is the core of a completely automatic coordinate measuring installation. Leica Automated Solutions also pave the way for Metrology Assisted Assembly. Work pieces can be processed automatically while the exact position is monitored by the 6DoF tracker system.

Leica Geosystems AG • Tel. +41 62 7376 767
press.metrology@leica-geosystems.com • www.leica-geosystems.com

Tool to Screen for Swine Flu

Coherix has developed a product that will help federal officials, hospitals, schools, airports and businesses screen for potential cases of swine flu. Coherix's ThermalSentry can detect elevated temperature levels in individuals passing by at border crossings, airports, and also can be used at sporting events, hospitals, factories and similar locations. The system is fast and accurate to one quarter of a degree. Originally developed during the SARS pandemic several years ago, it is a high-accuracy, non-contact, body temperature monitoring system targeted at real-time detection of influenza victims including swine flu. It remotely measures the skin temperature of subjects at a distance of 5 to 10 m. All persons in the field of view are monitored simultaneously so there is no need for people to line up in order to have their temperature recorded. The tool consists of a special purpose, high-tech camera connected to a computer.

Coherix
Tel.: +1 734 761 8989 • www.coherix.com

Line Scan Vision System

Cognex In-Sight 5604 line scan vision system combines industrially rugged In-Sight hardware and best-in-class vision tools with a high-speed, 1K line scan imager. This eliminates the need for PC based vision systems and separate line scan camera heads. The line scan sensor used by In-Sight is much more light-sensitive than the imagers used in most line scan cameras. This reduces the cost and complexity of the lighting and makes the system exceptionally easy to integrate into space-constrained areas on the manufacturing line. With support for hardware and software encoders, it has the flexibility needed to solve the image acquisition challenges across a wide range of applications involving fast moving discrete parts on a conveyor, cylindrical parts or large parts.

Cognex Germany
Tel.: +49 721 66 39 252 • info@cognex.de • www.cognex.com

INSPECT

Control

CONTROL: MATERIAL INSPECTION AND MEASURING INSTRUMENTS

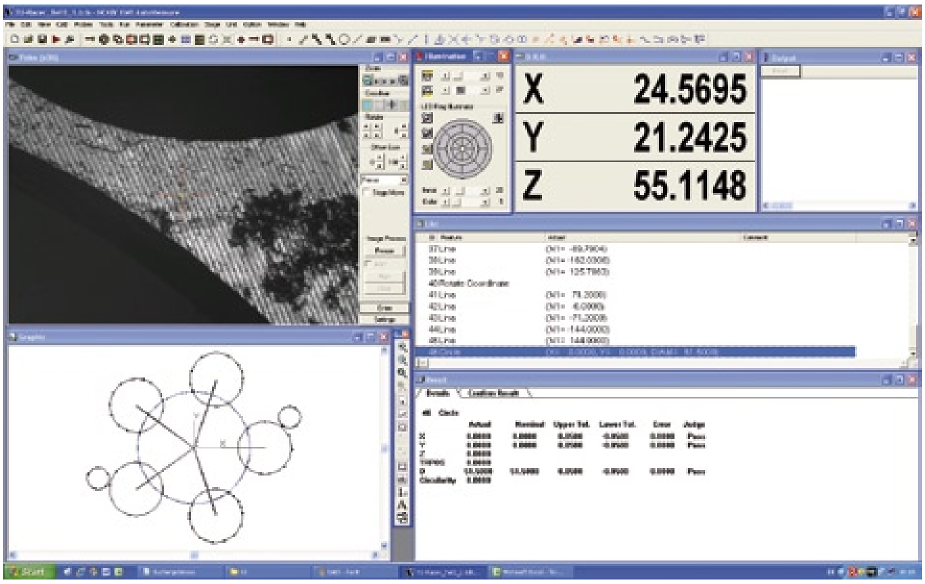
Optical measuring technology in industrial applications can be found in the Control section. Microscopy and image analysis for material inspection, the use of X-ray techniques for quality control in the field of foodstuffs, interferometry and photogrammetry for the recording of shapes in design and prototype 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.

In the Pole Position

Optical Measuring System Determines Geometry of a Differential Gear Casing

Students of the Vienna Technical University autonomously developed a prototype of a formula racing car. The TU's Institute of Production Engineering assisted the team in measuring a rear-axle differential gear casing. A Nikon optical measuring system determined the geometry.

The "TUW Racing" team, students of the Vienna Technical University, has been participating in the "Formula Student" racing season since 2008. The teams taking part in the competition are developing prototypes of a formula racing car, destined for the production of a thousand vehicles per year. At the end, the jury not only assesses the speed of the racing car but also features like acceleration, aerodynamics and the power-to-weight ratio. Also, the students have to present a cost plan and sales arguments.



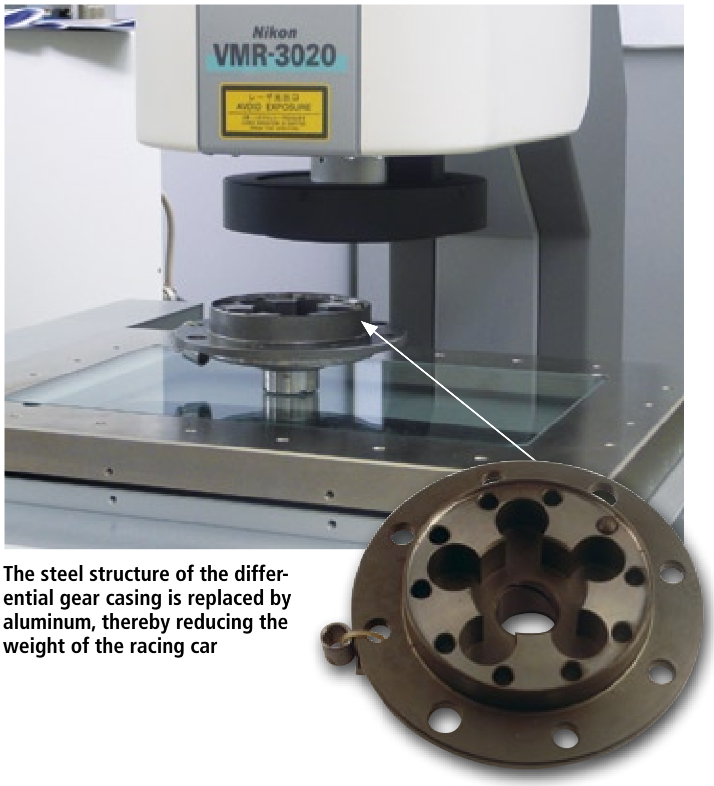
The user operates the measuring device by means of the Nexiv VMR Automeasure user interface

Lighter Differential

The students of the Vienna Technical University focused their development activities on optimizing the weight. The rear-axle differential gear casing is made of steel. The team's idea was to substitute this with a lighter material like aluminum for the casing. In order to produce the differential, it had to be geometrically measured, so that the geometrically given gears could be used in the lighter differential, too. The Institute of Production assisted the team by recording the dimensions of the bores with the aid of a Nikon optical measuring system.

Optically Recorded

The measuring system (Nexiv VMR-3020) has a wide work space, so that even large components like the differential can be measured. The device uses transmitted light and allows very fine increments in adding incident light. An outer and an inner ring light will give the user optimally adjustable lighting conditions. Operation of the device during measuring is carried out via the Nexiv VMR Automeasure soft-



The steel structure of the differential gear casing is replaced by aluminum, thereby reducing the weight of the racing car

▲ The differential casing is measured by the optical measuring system Nexiv VMR-3020, with the objective of substituting a different material for the casing

ware. A teach-in method was used to establish the sequence of measuring: The coordinate zero was positioned in the central bore, the seat of the rear axle. The diameter of the differential and the position of the five circumferential bores were determined by the Profil Pitch Vector software, the scanning of the profile being done with a distance-between-points of 0.5 mm.

Differential Casing Race-tested

The data from the software were finally exported into an Excel spreadsheet and the measuring report was established. With this, the students of the TUW Racing Team were able to produce the casing from aluminum. During the 2008 season, the component already saw its employment in three races, in Silverstone, England, on the German Hockenheimring and in Fiorano, Italy. And the weight optimization attained found its reward: In the first year of participation, already, the team was awarded a cup in the category of "Best Engineered Car".

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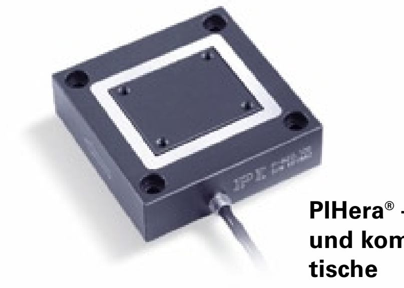

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Continuing on the Road to Success

Control 2009 – First Impressions and New Products

Nobody dared forecast the number of visitors to expect at this year's Control show – the uncertainty resulting from the economic crisis is too high. However, also in 2009 the Control was able to demonstrate why it is considered the leading trade show in the field of quality control. About 19,000 visitors did come to Stuttgart between May 5th to May 8th, with exhibitors praising the high technical level of their contacts. Following, the reader will find a selection of new products presented in Stuttgart, as well as a few snapshots directly from the show.

The IVS-400 industrial vibrometer by **Polytec** allows contact-free testing of components during production with respect to their compliance with oscillation threshold values. Thanks to the new filtering technology called Despec, measuring can be done on practically every technical surface. Says **Dr. Heinrich Steger**: "By directly measuring structure-borne sound, there is no need to isolate noise in the test bench."

www.polytec.com

Toshiba Teli's CleverDragon (marketed by **Framos**) offers a monochrome CMOS chip (sensor size 24.6 x 18.5 millimeters) with 4,096 x 3,072 active pixels at a pixel size of 6 x 6 µm, delivering 25 images per second at full resolution. "The image rate can be increased even more by selecting certain regions-of-interest (ROI); up to 48,662 fps are possible when selecting isolated image lines with a 10-bit data depth," as **Susanne Rehrl** tells us.

www.framos.de

For 40 years, **Physic Instrumente (PI)** has been developing and manufacturing standard and OEM products with piezo or motor drives for the micro and nano positioning technology. In Stuttgart, the company presented the M-900KOPS positioning unit for 2D scans with high precision and speed, as well as a number of hexapods and piezo motors.

www.pi.ws

Heat flow thermography makes non-destructive characterizing of joinings possible. Any mechanically sound welding seam has a good heat conducting capacity, while material defects disturb heat flow. Very fast infrared cameras like those supplied by **Thermosensorik** are able to measure a disturbed heat flow with imaging. Says **Dr.-Ing. Christoph Döttinger**: "In contrast to destructive testing, heat flow thermography allows a 100 % manufacturing control."

www.thermosensorik.de

In order to be able to supply telecentric lenses also for cost-intensive applications **Sill Optics** has developed a new series of lenses, comprising at first four lenses. Says **Wiebke Marzahn**: “The lenses are of identical outer length, ensuring interchangeability of the lenses.”

www.silloptics.de

For the first time, **Hommel-Etamic** showed their interior inspection sensor IPS 100, which allows a 360° round view and which is suitable for inspecting diameters of 75–110 mm at any bore depth. Says **Thomas Haupt**: “Thanks to the high scan rate of the ring-shaped sensor, the scanning sensor can be moved very fast, resulting in short test cycles.”

www.hommel-etamic.com

The confocal laser scanning microscope Lext OLS4000 by **Olympus** Germany allows contact-free roughness measurements of surfaces and measuring of almost perpendicular steep flanks. “High-speed MEMS allow a resolution which reduces the time required to produce a 3D image by half,” is how **Markus Fabich** describes a further advantage of the system.

www.olympus.de

The modular InfiniteFocus sensor concept by **Alicona Imaging** allows the integration of high-resolution measuring procedures into production in various ways. Explains **Dr. Stefan Scherer**: “Depending on requirements, you may choose between implementation as a fixed mounted sensor, or as a robot-supported measuring system.”

www.alicona.com

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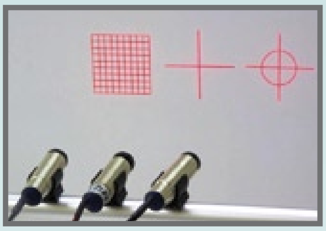

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Keyence with their VW-6000 presented a new movement analysis digital microscope. **Martin Müller** is convinced that with the VW-6000 model "a completely new microscope has been created that offers possibilities up to now unheard of for the enlarged imaging of fast movements." The device makes high-speed imaging of up to 24,000 frames per second possible.

www.keyence.de

Baumer presented as their highlight of the fair the TZG01 digital 3D camera with TOF (Time Of Flight) sensors. "The advantage lies in the fast three-dimensional registering of objects with indication of their respective dimensions and spatial orientation," says **Jens Wober**. Possible fields of application of the camera are conveying and logistics.

www.baumergroup.com

Yxlon, with its process called Y.HDR-Inspect, is promising a new dimension in x-ray inspection. HDR stand for high dynamic radioscopy, employing a special filter delivering a low-noise live image that makes the object appear "as if made of glass". Says **Dominik Schlösser**: "HDR makes it possible to recognize all defects at a glance." There is no longer a need to continuously adapt x-ray parameters to thin or thick areas of the object to be inspected.

www.yxlon.com

The new DHM (digital holographic microscope) presented by **Schaefer Technology** is a 3D real-time microscope. It is able to carry out up to 300 topographical measurements per second at a resolution in the nanometer range," as **Dr. Marcus Weth** explains. Such speeds result from the simultaneous registering of phase and intensity information in a digital hologram.

www.schaefer-tec.com

NET New Electronic Technology presented their program of high-resolution megapixel CMOS cameras, black-and-white and color cameras with analog interfaces, as well as the necessary equipment of lenses and LED lighting systems. Assures **Christian Merten**, "our products cover all requirements to successfully master imaging tasks in every industrial application."

www.net-gmbh.com

The Werth Video Check by **Werth Messtechnik** allows high-precision measuring, thus being the ideal base for Renishaw's SP80 passive scanning system with integrated scales. Says **Thomas Heger**: "On account of its high-precision mechanism values of tactile deviation of a few tenth of µm are possible with the suitable basic equipment."

www.werthmesstechnik.de

Nikon's NeoScope JCM-5000 is a very compact yet highly efficient table REM, combining the advantages of optical microscopes and traditional REM. **Udo Schallenbach**: "Handling is as simple as with a digital camera, but at the same time producing high-resolution images of persuasive enlargement and focal depth."

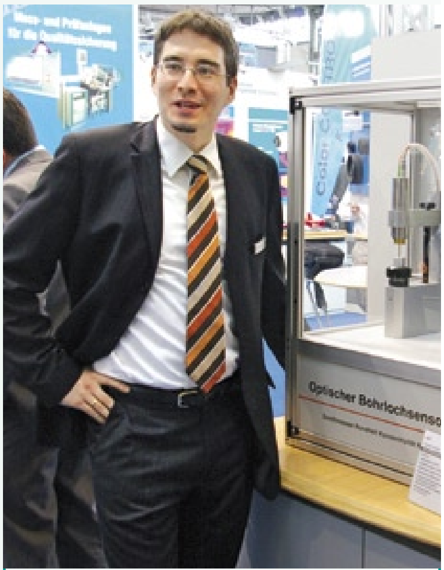
www.nikoninstruments.eu

Very small and simple to operate, that is the PI Thermal Imager with USB 2.0 interface for online applications by **Optris**. **Torsten Czech** on the advantages of the thermography system: "The user will find high precision in a temperature range of –20–900 °C, together with an excellent thermal sensitivity (NETD) of 0.08 K."

www.optris.de

GE Sensing & Inspection Technologies with its v/tome/x L 300 introduces a new CT system which is equally suited for 2D/3D inspection as well as for precise dimensional measurements on components. Explains **Dr. Oliver Brunke**: "For the first time recognition of detail down to 1 µm for a 300-kV x-ray tube has been reached."

www.gesensinginspection.com



Micro-Epsilon presented their sensor system for interior-wall inspection of bores. The rotating sensor can inspect diameter, roundness, concentricity and straightness of bores. **Martin Kucera** explains that "the miniaturized confocal sensor can be used even for bore diameters from 4 mm upwards."

www.micro-epsilon.de

Camera Line Now Available with USB Interface

The new USB 2.0 based cameras from Jenoptik in the ProgRes CMOS and CCD research camera line have been optimized according to customer wishes. The CMOS camera models ProgRes CT1, CT3 and CT5 are now equipped with USB interface. With an extended resolution up to 5 Megapixel and a live frame rate up to 20 fps the new USB camera of the CMOS line delivers faster high resolution with excellent image results. New in the ProgRes CCD research series are the USB models ProgRes CS and MS. These extraordinary and very sensitive cameras perform high sensitive imaging with up to 50 fps in full resolution (CCIR/PAL). One can also get the ProgRes CF and MF cameras now with USB interface with faster live imaging in SXGA resolution with 15 fps.

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In the world of 3D measuring arms, the Romer Infinite 2.0 sets new standards in ergonomics and accuracy. Patented rotational axes for infinite rotation, fast probe changing, WiFi communication and a high-performance battery ensure unlimited mobility and the highest degree of flexibility. Due to the scuff-proof carbon fiber tubes, the portable CMM easily delivers reliable measurement results even under difficult environmental conditions on the shop floor. The Romer Infinite 2.0 is also available as premium version Infinite 2.0 Plus. This top-of-the-line model's volumetric accuracy and point reproducibility are unique. Equipped with Perceptron's V4i or V5 laser scanner, it qualifies for demanding reverse engineering applications.

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Innovative LED Illumination Modules

Leica Microsystems is presenting its innovative LED illumination modules for stereomicroscopes, which offer optimum illumination even for difficult material samples. Thanks to modern LED technology, operating costs are significantly lower than for conventional halogen illumination. With its practically vertical illumination light path, the Leica LED3000 NVI solves even challenging illumination applications such as samples with indentations and drill holes not accessible using standard lighting components. The Leica LED5000 CXI (coaxial illumination) provides excellent detailed illumination of flat, highly reflecting surfaces such as wafers or polished metal samples, and substantially enhances contrast. Both illumination modules can be optimally combined with Leica stereomicroscopes for routine applications.

Leica Microsystems GmbH
Tel.: +49 6441 29 0 • info@leica-microsystems.com • www.leica-microsystems.com

New Optical Metrology Instrument

Olympus has introduced the Lext OLS4000, the latest version of the highly successful Lext confocal laser scanning microscope metrology system. The OLS4000 brings a number of additional features and enhanced functionality, including near-vertical slope capabilities, larger optical zoom and navigation overview window. The new software also brings even the most complex of processes within easy reach of a broader range of users, with the use of different user interface sheets for the main tasks – acquisition, analysis and reporting. As well as these internal functional improvements, the whole system has a sleeker look and now only requires a single control unit. The system not only matches the challenges of the measurement laboratory, but also leads the way in establishing optical technology as the most flexible measurement systems available.

Olympus Life Science Europa GmbH • Tel.: +49 40 2 37 73 0
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Video Gallery Demonstrates Applications

Specialized Imaging has announced a major expansion of their online video gallery. Located at www.specialised-imaging.com/video.htm, Specialized Imaging have assembled a selection of video files to demonstrate the growing array of applications that benefit from their ultra-high speed, high resolution imaging systems. Using data provided by customers around the world, videos are available demonstrating ultra-high speed applications including aeroballistic studies, automotive lean-burn technology development, crack propagation, detonics, plasma injection, space probe flight characterization and sports science.

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Adapts to the Measurement Task

The new optoNCDT1402 laser sensor from Micro-Epsilon replaces the company's previous optoNCDT 1401 product. The new sensor provides improved performance and extreme flexibility. This flexibility comes from a brand new teach-in function, which can be used to limit or change the measuring range for each application. In this way, both the resolution and the linearity of the sensor in the pre-set measuring range can be significantly improved. This is of particular benefit in applications where only a small measuring range but high performance is required. The flexibility of the system is further enhanced by an integrated swiveling cable connector, which can be used to change the direction of the cable output to suit the individual application. By utilizing a CMOS sensor, the optoNCDT 1402 has an increased measuring rate of 1.5 kHz making it suitable for rapid processes.

Micro-Epsilon Messtechnik GmbH
Tel.: +49 8542 168 0 • info@micro-epsilon.com • www.micro-epsilon.com

Outstanding Resolution and Color Quality

Olympus has introduced the new SC30 easy-to-use color camera for high quality microscopy imaging. With superior resolution and quality, outstanding color reproduction is ensured. Suitable for use in both material and life science applications, this camera is designed to capture fast frame rates and has an excellent cost-to-performance ratio. This makes it an ideal introductory model for any applications requiring digital image acquisition. With a native resolution of 2048 x 1532 pixels and multiple binning modes (2x, 3x, and 4x), the SC30 camera is able to achieve high levels of sensitivity and fast frame rates during live cell imaging. Using the 4x binning mode, 49 frames per second (fps) can be captured at a resolution of 508 x 384 pixels.

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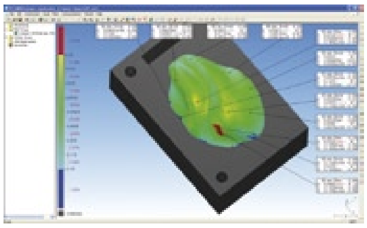
Point Cloud Processing Software

Wilcox Associates announces the immediate availability of PC-DMIS Reshaper software. PC-DMIS Reshaper is a comprehensive 3D point-cloud processing program that can be used to collect or import large quantities of three dimensional point data for manipulation and processing for downstream processes such as CAD modeling, Computer Aided Manufacturing (CAM) or rapid prototyping. Data collection can be accomplished either via a "live" direct connection to a digitizing device, such as a Romer portable measuring arm with a laser scanner, or via import from more than a dozen 3D data file formats. Point clouds, which can be imported with no file size limitations, can be cleaned, merged, and edited from the user interface, and then rapidly converted into a polygon mesh model.



Hexagon Metrology
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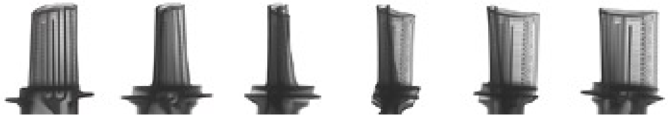
New NIR Cameras with GigE

With the new monochrome MV1-D1312-40-GB and MV1-D1312I-40-GB cameras, with Gigabit Ethernet interface, Photonfocus is introducing two new CMOS cameras, based on the newly developed third generation CMOS imagers A1312 and A1312I from Photonfocus. The new CMOS imager A1312I was specially developed for NIR applications up to 1,100 nm. The MV1-D1312I cameras provide a high dynamic range of up to 120 dB with the well known LinLog technology patented by Photonfocus. The new cameras are equipped with all standard features needed for common applications whilst offering an outstanding image quality. The A1312I image sensor series is designed and fabricated in a 0.35 µm CMOS technology optimized for image sensors to achieve an outstanding sensitivity and quantum efficiency.

Photonfocus AG
Tel.: +41 55 451 00 00 • sales@photonfocus.com • www.photonfocus.com

The New Dimension in X-ray Inspection



With Y.HDR-Inspect, Yxlon is presenting its new standard solution for digital image generation in visual X-ray inspection. This solution is going to find wide-ranging fields for deployment, above all in the aviation, aerospace and automotive industries, as well as in foundry casting. Yxlon uses the abbreviation HDR for its procedure involving "highly dynamic radioscopy". A special filter is used here to generate a live image on which the irradiated inspection item seems to be "made of glass". When the operator moves the inspection item within the beam while being X-rayed, statements regarding the spatial position of a flaw in the inspection item and its three-dimensional characteristics can be made quickly and with assurance. Above and beyond that, flaws in an inspection item's various material thicknesses can be detected and localized using this solution, but without having to continuously adjust the X-ray parameters.

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Interview with Dr. Juergen Geffe, Managing Director of Vision & Control

INSPECT: Dr. Geffe, your company Vision & Control is considered to be one of the pioneers in the area of optics and illumination technologies for machine vision. What are the roots of this company focus?

Dr. J. Geffe: Our roots date back to 1991, when Vision & Control unveiled LEDs for illumination systems. In 1993, we introduced the principle of telecentric imaging and illumination for industrial image processing.
Innovative employees and close collaboration with university and vocational schools in Thueringen continue to be the cornerstone of such innovations. The excellent practically-oriented education offered at the University of Ilmenau and at our universities of cooperative education in Eisenach and Gera exemplify this synergy.

How do you see the impact of illumination on the total performance of a vision system?

Dr. J. Geffe: I believe that up to 60% of the success of Machine Vision solutions is linked to the robustness and capacity of the light sources used.
The goal of our work has always been to develop robust illumination systems that are not only fit for industrial applications, but also allow the user to achieve 100% reproducibility of analysis results through the interaction of illumination and optics. Every industrial installation must meet this criterion as a measure of quality, not price. It is in this context that our Vicolux system has made a significant contribution to the illumination components group.
Industrial customers of Vision & Control solutions can choose the light sources they require from a wide variety of standard products. Our Vision Academy in Erfurt, for example, shows how to combine effective contrasts with long-term stability. Potential users should, in any case, know that suitable illumination systems are available for any situation imaginable, regardless of the complexity or difficulty involved.

You made use of LED elements for machine vision as early as the mid 1990s. Have there any significant improvements taken place afterwards at all?

Dr. J. Geffe: Light sources have indeed become considerably more advanced in the last few years, whereby Vision & Control was among the leaders in developing innovative illumination systems for interior applications. Our knowledge of LED illumination technology is profound, having introduced it back in 1991. Since then, light output has increased by over 200%. Needless to say, LED technology will continue to evolve and lead to additional growth in this area.

What is your view on the future development for optics and illumination technologies? What are the upcoming trends? What are your plans?

Dr. J. Geffe: The seemingly unlimited number of possibilities currently poses the greatest challenge. The wide variety of control options and the possibility of wide input power supply ranges, thermal temperature management, and freely definable brightness control with respect to time and location by way of line illuminations of up to 2 m in length, for example, further increase the range of applications possible in each sector by including areas no one has thought of yet. German ingenuity thus continues to be in demand.
Vision & Control is capable of quickly and economically developing made-to-order optical and illumination components for OEM customers and manufacturing them in Germany using state-of-the-art technology. Our list of references already speaks for itself.

Vision & Control, founded by yourself, is today a very successful company in the machine vision industry. What is your formula for success? Would you encourage young people to start-up a vision company in these times today?

Dr. J. Geffe: Image processing will no doubt continue to be a market with potential. Although growth rates may not be as high as they have been, all indications point to stable overall development.
Our recipe for success has always been rooted in innovation and trust as the key

ingredients for achieving productive collaboration in the company.
Founding a company in such a financially challenging year is anything but easy. However, great ideas always have a chance to succeed.
Our group can help prepare individuals for entering the market. Simply contact myself or submit an application for an internship position or to complete a degree dissertation. We will then determine what possibilities are available and devise a strategy for success together.

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www.vision-control.com

Adlink Technology	32
Aerotech	39
AIA	14
Aicon 3D Systems	40
Alicona Imaging	45
Allied Vision Technologies	14, 39
Aqsense	30
Baumer	46
Cognex Germany	30, 32, 40
Coherix	40
Dalsa	15, 31, Outside Back Cover
Darmstadt University	18
Edmund Optics	23, 30
Eltrotec Sensor	30
EMVA	14
Falcon LED Lighting	9, 40
Fanuc Robotics	17
Faro Europe	16
Flir Systems	15
Framos	9, 31, 44
Fujinon Europe	16
Gardasoft Vision	32
GE Sensing & Inspection Technologies	47
Hommel-Etamic	45
Hexagon Metrology	49
IDS Imaging Development Systems	14, 15
ILEE Laser Innovation	45
IMS Research	15
Innowep	5
Intercon 1	40
JAI	15
Jenoptik Laser-Optik-Systeme	48
Kappa	38, 39
Keyence	46
Leica Geosystems	40
Leica Microsystems	14, 48
Matrix Vision	19
Micro-Epsilon	47, 48
Mikrotron	31
MVTec Software	9, 15
NET New Electronic Technology	37, 46
NeuroCheck	7, 22
Nikon	42, 47
Northwire	31, 32
Olympus Deutschland	45
Olympus Life Science Europe	48, 49
Opto Engineering	25
Optris	47
Pepperl + Fuchs	6
Photonfocus	34, 49
Physik Instrumente	43
PMDTechnologies	28
Point Grey Research	Inside Front Cover
Polytec	44
PPT Vision	39
QuinLogic	39
Rauscher	3
Romer	48
Schaefer Technologie	46
Jos. Schneider Optische Werke	25
SensoPart Industriesensorik	26
Servo-Robot Group	36
Silicon Software	35
Sill Optics	45, 47
Specialised Imaging	48
Stemmer Imaging	29
StockerYale	32
SVS-Vistek	30, 31
Thermosensorik	44
Tordivel	9
VDS Vosskühler	49
Vision & Control	50
Volpi	10, Cover
Werth Messtechnik	46
Yxlon	46, 49
Z-Laser Optoelektronik	20

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Genie™ cameras are fully compatible with DALSA's Sapera Essential Vision Software.
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