10. VOLUME
SEPTEMBER 2009

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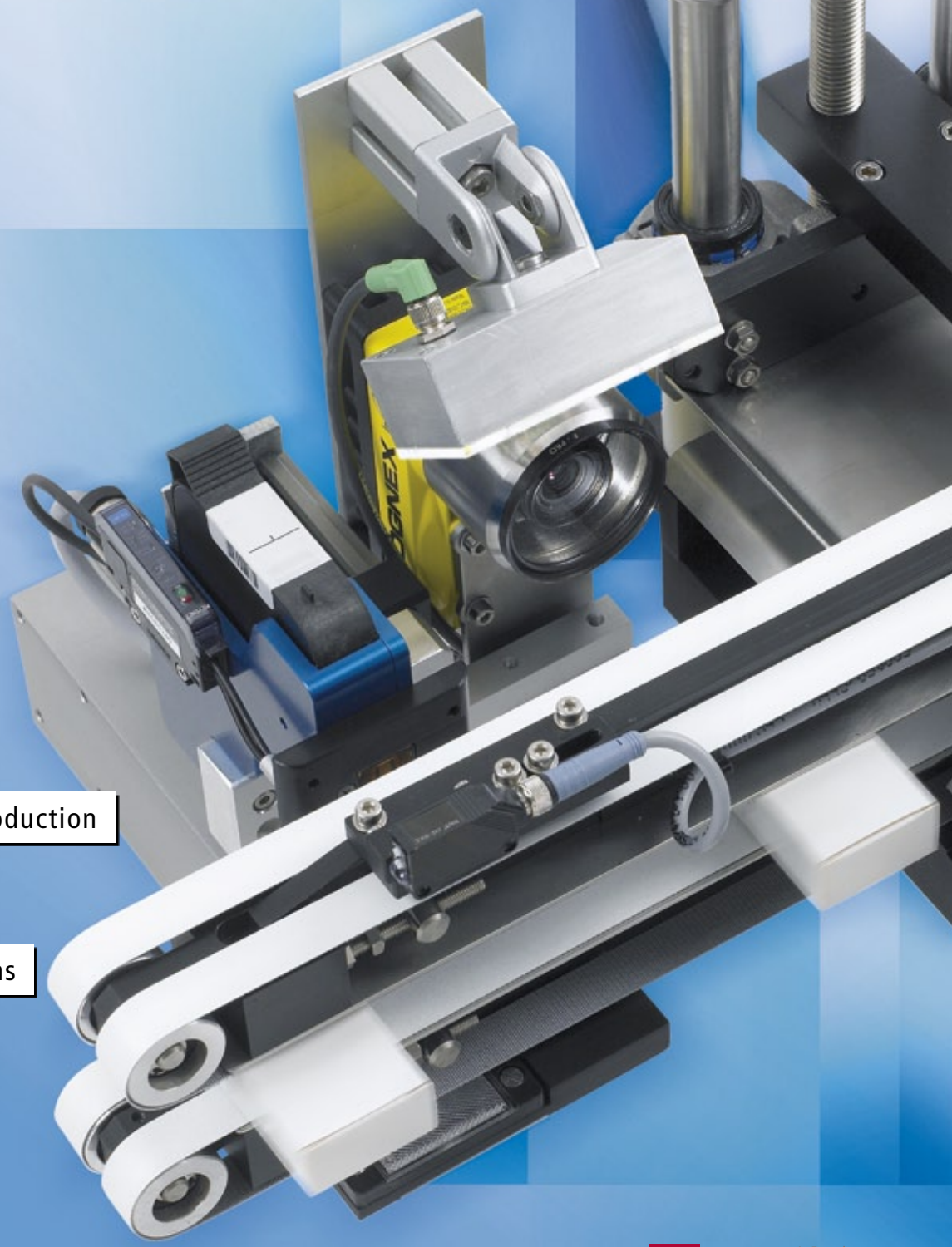
VISION ▸ AUTOMATION ▸ CONTROL

INSPECT



European Market Data

Quality Assurance in Production

Camera Interfaces

Photovoltaic Applications

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Anorexia?

88 pages. That was the size of the corresponding issue of the INSPECT last year. About one third more pages than offered by this current issue in front of you. You surely already noticed that trade journals are significantly thinner this year and that they show a frightening tendency towards anorexia the further the year progresses. Why is that so anyway?

A trade journal is a product, as much as a consumer magazine is, or a book. This product needs to generate an income. That is exactly the same as it is with the products produced by your own company. For a trade journal the main source of income is advertisement, placed by companies who have an interest to communicate with you, the reader of the journal. The amount of advertisement continuously decreases since the beginning of this year and subsequently the income of trade journals abates. Now, one could argue splendidly if it is wise and well to save on market communication especially in economical difficult times, or if it were not even more important now to show a high visibility. On the other hand, one may not be mistaken that for many a company it is no longer a choice where to save.

As a consequence, cost saving has to be done by the publisher of trade journals as well. The first publishing houses announce significant economical imbalance and fight for survival. Others meet the market situation with magazines that rather remind you of a student's notebook in size and haptics.

Not only in light of this comparison, the 54 pages of the current INSPECT are really good.

Is there no need to save costs for INSPECT as well, you might ask yourself now.

Yes of course there is, but we are lucky to have a very sound basis in more than one aspect: The companies that place their ads in the INSPECT know that in doing so they reach their customers of today and of tomorrow in an optimal way and you, our readers, confirm for them that this choice is the right choice.

Take a close look at the advertisements on the 54 pages in front of you: for those companies it is a priority to be noticed by you and to communicate with you. This also shows economical strength, strategic sustainability and faith in their own future. Suddenly these ads have a whole new meaning in addition to featuring a product.

For us they provide the possibility to present to you with each issue a versatile, comprehensive and independent information package. In German and in English language. In each issue. This is complemented with our online presentation at www.inspect-online.com, taking up the topics from the printed issues and enriching them with up-to-date news on a daily basis, again in German and English language. During the summer our portal was given a facelift, that is – as with cars – a technical and optical makeover. Especially the interactive and the multimedia aspects, naturally rather out of reach for a print product, are offered by the website: search engines, webcasts, Buyers Guide database, job search, online polls, to mention but a few. But not only that: also the printed edition features some new components with which we hope to generate value and deliver delight.

So please enjoy the discovery.

Yours, Gabriele Jansen
Publishing Director INSPECT
gabriele.jansen@wiley.com

TOPICS

COVERSTORY

High Troughput at the Relais Station ▶ 36

Benef´cent Is the Might of Flame ▶ 48

VISION

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Extensive and Explicit

EMVA Market Survey Provides Basis for Strategic Planning

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The machine vision industry in Europe has seen a steady growth in the past years. The annual survey "European Vision Technology Market Statistics" shows that 2008 was another record year, despite the first effects of the global economic downturn. Especially vision sensors and vision software could show significant growth.

European Trends

Easy-to-use and inexpensive standard systems, such as smart cameras and in particular vision sensors, could again gain market share in the previous year. Due to advanced hardware and software, they are able to perform tasks for which – not long ago – more complex solutions had to be employed. However, high-end and application-specific systems still hold the biggest share of machine vision turnover among all product categories.

Inspection remains the largest application field of machine vision technology, both in the production of piece parts and continuous – webbed – materials (foils, sheet metals, paper etc.). The biggest customer industries for systems and components were the automotive and the electric/electronics industry, but even outside the industrial production sector, there is more and more potential for new applications of vision technology.

Outside the European borders, European vision companies recorded good sales to the Americas and Asia. North America was the major destination for shipments into the Americas, while sales to the main Asian countries were more balanced. This underlines the trend of the growing importance of the export business. Vice versa, in terms of sourcing, European vision companies managed to purchase mainly within the European borders.

New Record in Vision Turnover

Recorded sales volumes of the participating European vision companies reached almost € 895 million in 2008, a new sales record. Just short of 73% of the total sales were realized within Europe. Sales to Germany, the largest market for machine vision products in Europe, increased by 4.3%, and supplies to Italy even rose double-digit by 14%. Also France, Turkey and Greece, as well as the United Kingdom and Ireland performed well above average. Besides that, sales to overseas could be further developed in their share of total turnover. Sales to the Americas rose by 11.1% to a share of 12.9% of total revenue, and business with Asia grew by 4.3%. Asia now holds a share of 13.6% of total turnover.

EMVA Market Data

The „European Vision Technology Market Statistics" is an annual study issued by the European Machine Vision Association (EMVA). All European machine vision companies are invited to participate in the annual EMVA market survey and in turn will receive the complete results free of charge. All other interested parties are invited to purchase the study from EMVA.

Systems Lead the Product Categories

Sales of vision systems remained at a high level in 2008, and accounted for 52.5% of the total turnover. All vision systems, namely application specific systems, configurable systems, smart cameras, and vision sensors, managed to increase turnover. In particular vision sensors, the shooting starts of last year amongst vision systems, once again grew double-digit and increased turnover by 26.2%. With almost € 336 million in recorded sales, application-specific systems, however, have the highest share in the category of vision systems.

Vision components increased turnover by 2.9% as a whole, and have a share of 43.2% on total turnover in 2008. Herein,

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with 27.1%, cameras hold the highest share of the different components. Sales of vision software rose above average, with an increase of 12.3%. Only frame grabbers registered a decline in turnover of 9.4% compared to 2007, a continuation of the development of earlier years. Figure 2 shows the percental changes in turnover of the different vision products between 2007 and 2008.

Vigorous at Staff Size 33

The machine vision industry in Europe is still dominated by Small and Medium Enterprises (SME). On average, in 2008, the companies in Europe employed 33 people. In Germany this size was slightly exceeded with a staff of 40 whereas Italian companies have 15 employees on average. With 85%, the vast majority of machine vision enterprises in Europe employed less than 50 people in 2008. Every second machine vision company in Europe has 10 employees or less.

Over the past years, a trend has emerged that an increasing number of companies in the engineering industry, the automation industry and among the sensor manufacturers set up an internal machine vision group, and the proportion of "pure" vision companies is declining. In 2008, 45% of the companies stated that machine vision is only part of their business.

Some 6% of the participants were subsidiaries of companies from outside of Europe.

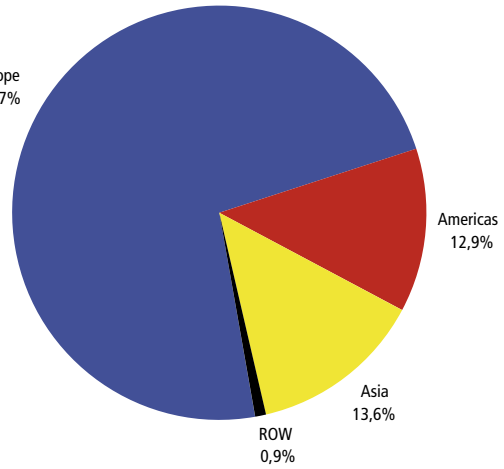
Automotive Still Leading

The major part of turnover in 2008 was realized with end-users (43%), followed by Original Equipment Manufacturers (OEMs) with a share of 37%. Distributors accounted for 18% of the total sales.

On the European level, the automotive industry remained the largest purchaser of vision systems in 2008, although sales went down by 8.2 percentage points, due to the beginning slowdown of the economy in the last quarter of the year. Other major customer industries were the glass industry, the wood and paper industry – which is strong in the Nordic countries and in Italy – and also the electric/electronics industry, the metal industry and companies in the pharmaceutical and cosmetics industry.

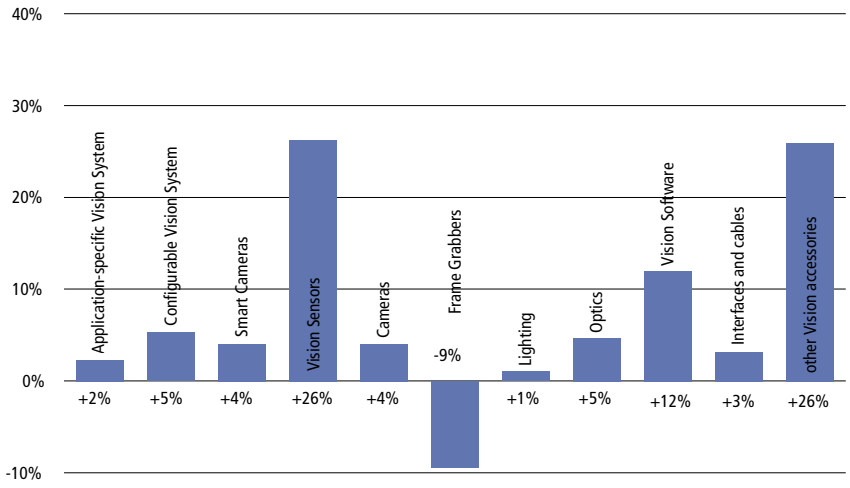
Great potential for new applications of European vision technology can be found outside the area of industrial production as well. The non-manufacturing sectors, which include medicine, intelligent traf-

Total turnover* of European Vision product suppliers 2008
by regions in %

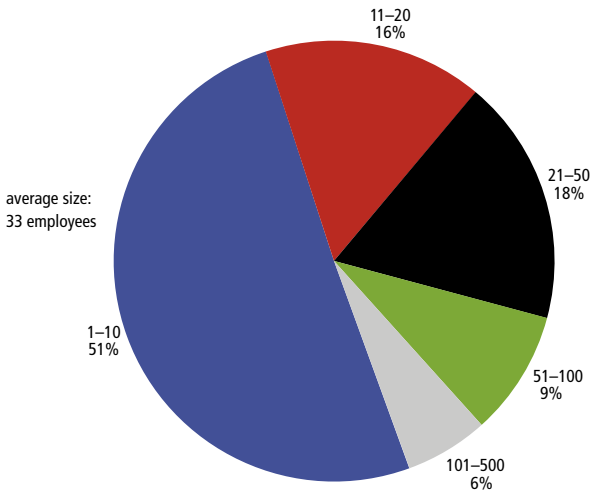


* Turnover participat

Turnover of vision products of European suppliers
change 2008/2007



Structure of vision companies in Europe 2008
Shares of companies by employees in the vision sector in %



FOR THOSE IN SEARCH OF A SOLUTION

Vision Integration Area

Platform for system integrators and solution providers of machine vision.

VISION 2009, Hall 4, Booth C91
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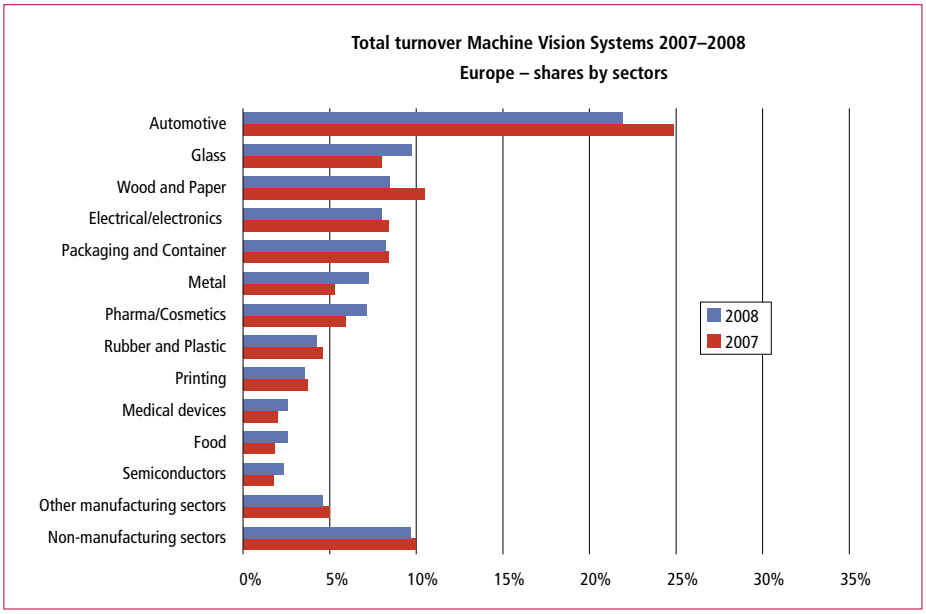

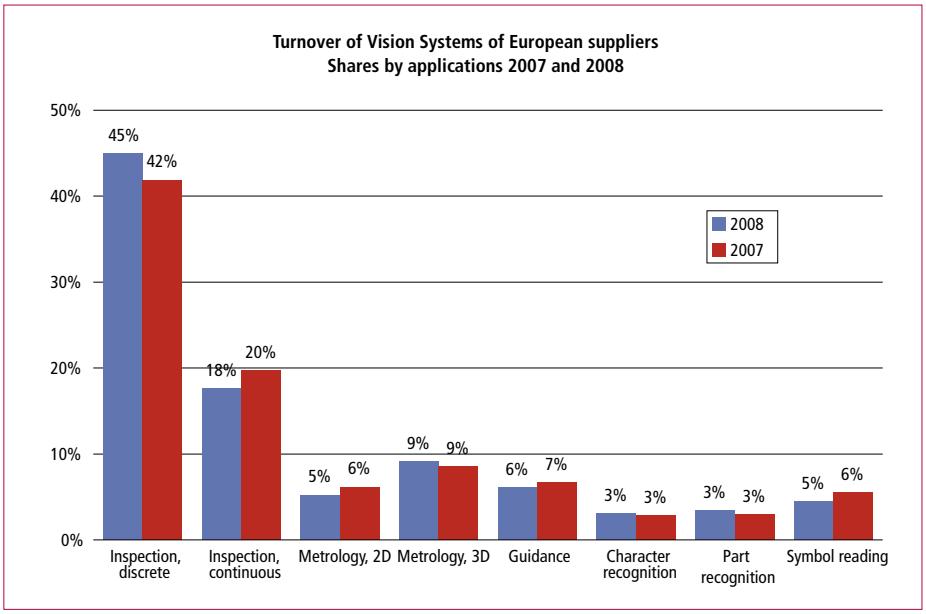

fic systems, security and surveillance, amongst others, already hold a share of 9.7% on total turnover in 2008.

Inspection Predominates

Among the main applications of European Vision Technology, inspection is still by far the most commonly used. Although turnover of continuous inspection decreased from 2007 to 2008, the 11.4% rise in turnover of discrete part inspection compensated this decline, and the share of turnover of all inspection applications again increased to now 63%. Besides inspection, metrology has a 14% share on turnover, with 2D and the advancing 3D applications combined. Guidance, which includes robot guidance but can also be applied to other tasks, had a 6% share of turnover in 2008, followed by symbol reading (5%), character recognition and part recognition (both 3%) .

Country Reports: Germany and Italy

The annual EMVA market survey traditionally features a separate country report on Germany, prepared in close cooperation with the German association, the machine vision group within VDMA. In addition to that and for the first time ever, a second separate country report is provided in the 2008 market study: based on the high number of participating companies and additional personal interviews a detailed country report on Italy delivers specific data for turnover broken down to product categories, applications, industries and export regions.

More country reports are planned for the upcoming years.

Economic Outlook

Machine vision is an enabling technology for automation, and European companies are well positioned in the global markets. Still, in 2008, the long and continuous period of growth for the European machine vision industry came to an end, for the time being. Clearly, 2009 will become the year with the biggest challenge in stock for this relatively young industry. EMVA estimates that sales in 2009 could decline by more than 20%, compared to the total sales realized the year before. Despite that, the general need of further automation remains in all customer industries. It is true, that many enterprises at the moment are not able to finance new projects or reinvestments, but cost saving, increase of productivity, environmental protection and – most of all – the demand for best quality among the customers of machine vision and their respective customers will further boost automation in the near future.

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Machine Vision Demystified

To demystify the machine vision buzz words is the goal of the Sick brochure with the unostentatious title „Introduction – Machine Vision". Easy access for beginners and so-called vision virgins shall be provided and after reading the close to 60 pages the novice is supposed to understand the basic machine vision terminology, to know about some possibilities and also some limitations of machine vision and to have gained enough theoretical understanding to be able to begin practical work.

That sounds modest enough, but it is exactly this confinement to the essential that makes it an art. It would be easy enough to write a lot about a technical discipline that is still widely unknown to many engineers and technicians and especially machine vision with its segments of optics, electrical engineering, computer sciences, mathematics and mechatronics is an extensive and in its details rather complex field.

This level of complexity, often discouraging in the beginning, is broken down to a useful and coherent level by the Sick "Introduction" without diverting into shallowness. The main areas of cameras and image acquisition, illumination (including an excursion into triangulation), processing and analysis und last but not least communication are presented with refreshingly short and precise explanations, didactically well supported by a lot of pictures and illustrations. Examples and exemplary figures point out the respective products by Sick. Since this self-marketing is done thankfully unobtrusive, it does not impair the quality of the brochure at all. The "Introduction" is rounded off with practical advices regarding the process flow of typical machine vision projects and the respective do´s and don'ts. In addition, a useful appendix is provided with a couple of helpers like a rule of thumb for focal length calculation or a table with the IP classification relevant to vision projects. To be especially commended is the excursus on resolution, repeatability and accuracy – a source of constant misunderstanding between machine vision suppliers and machine vision users.

Altogether the brochure is a well-done introduction fully complying with its claim to make life easier for machine vision novices at their first steps into the new field.

The "Introduction – Machine Vision" can be obtained from eva.persson@sickivp.se.

Quality Is Everything – Everything Is Quality

Compact Inspection System for the Pharmaceutical Industry

Millions of people worldwide can suffer from the same disease, this holds true for the flu as well as for back pain. However unfortunate this may be for the individual, it is at the same time the basis for a diverse market involving challenges at many levels throughout the value-added chain right down to the final consumer. Not only because the health of the customer is at stake in the end, automation and full traceability of products are of such significance in the pharmaceutical industry.

To date manufacturing in the health sector was characterized by the separate incorporation of the different components of quality assurance and identification in plants and process lines. This called for the design of operation, programming and communication between the components and the process leading to possibly compromising on production optimization. It was not possible to take sufficient advantage of the potential for flexibility and optimization when performing engineering for implementation, continuous process adaptation, and plant maintenance.

This situation changes with the compact inspection system that has been developed thanks to a partnership between Krempien + Petersen GmbH and the German company Mettler-Toledo Garvens GmbH, a subsidiary of Mettler Toledo, the international manufacturer of precision instruments. In this flexible, modular quality control station all components are linked to create an optimized process. The complete system solution includes the following: a conveyor belt system offering variable adjustment, a printer made for 2D code and clear text, In-Sight vision systems from Cognex, pneumatic ejection of nonconforming parts and the control system. In addition, a dynamic check weigher from Mettler Toledo can be incorporated in the system concept or used to upgrade an existing device. All these components are controlled by a single central user interface 'KuP-Vision'. The latest guidelines of the pharmaceutical industry have been taken into account for communication and documentation

▶ **This compact control system fulfils the hygiene requirements of the pharmaceutical and medical engineering industry** (photo: Mettler Toledo)

▼ **Operation and programming of the system is especially comfortable and reliable for the user**

including user administration. In short: a complete system solution optimized for the needs of the pharmaceutical industry with Mettler Toledo as the global supplier.

Stringent Regulations Offer an Opportunity

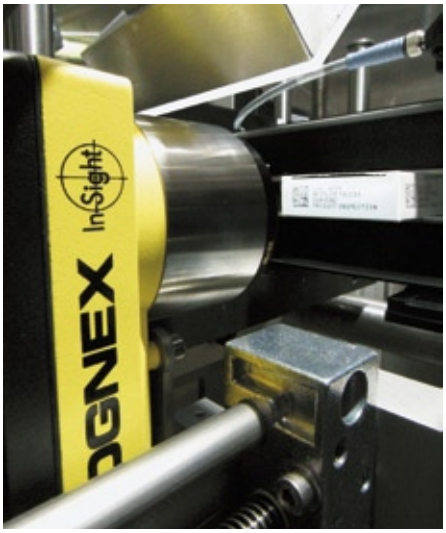
The sooner sources of error and nonconforming product are detected in the production process; the more smoothly subsequent manufacturing stages will proceed – thus saving direct and indirect costs along the entire value-added chain. The basic conditions for strict quality control, quality management and detailed documentation of production steps are already defined by a whole series of national and international directives and standards from different business sectors. They also include the EN ISO 15378 norm with its special requirements for the manufacture of packaging materials for the pharmaceutical industry. It is highly relevant in competition terms that businesses comply with the latest technical standards and take account of new regulations coming into force, particularly in the critical field of pharmaceutical manufacturing.

This includes the new EU directive that is currently planned. Both the European Association of Hospital Pharmacists (EAHP) and the European Federation of Pharmaceutical Industries and Associations (EFPIA) have spoken out in favour of the stipulation for all medical packaging to be equipped with the 2D code. The aim of this is to guarantee a high level of product transparency in the complex European supply chain as well as full traceability. This also makes a key contribution to patient safety, ensuring that the proper drug is available to the right patient in the correct dose during the exact time frame. In addition, this new European directive represents an important step towards preventing counterfeit medicines.

Fast Production Cycle under Control

The modular system design of the unit with an overall length of just 800 mm ensures a high level of flexibility for checking different packaging sizes as well as upgradeability thanks to the option of adding extra inspection functions at any time. The individual packaging is transported to the printer and the subsequent inspection area with vision systems between two conveyor belts. This ensures precise fixing of the packaging, while the variable gap width adjustment provides for the handling of different packaging sizes.

Accurately fixed in place between two conveyor belts, the pharmaceutical packagings are passed to the print head, followed by the In-Sight 5603 vision system (photo: Mettler Toledo)



Operating in fast cycles of up to 400 packagings/minute, the In-Sight 5603 vision system carefully checks the 2D matrix codes as well as the legibility of the four lines of clear text (photo: Kamillo Weiss)

The system has to cope with a dynamic work rate of up to 400 packages a minute: Just 100 ms are available for the inspection process including image acquisition and analysis. Depending on the requirements, a whole series of control functions have to be managed in this time frame. The specialists at Krempien + Petersen (KuP), a house for vision applications and a Cognex Partner System Integrator (PSI), opted for the fully autonomous, compact In-Sight vision system manufactured by Cognex. It is possible to install up to four of these systems in the inspection area of the unit. This means that it can be upgraded at any time to cater for increasingly complex requirements.

The first installed application involves the powerful In-Sight 5603 vision system with a high image resolution of 2 megapixels. This system reads the 2D matrix codes just printed and the labeling consisting of several lines of clear text and also checks their exact positioning on the packaging. Outstanding operational reliability is provided here by the vision tools of the powerful vision software packages PatMax and IDMax from Cognex. Missing or faulty printing is detected immediately, with rejection of the packaging guaranteed thanks to performance of a countercheck. The high resolution of this vision system ensures precise identification of the required features, even with different packaging sizes.

Convenient and Safe

A feature that is of special importance for users is 'KuP-Vision', the operating interface developed by KuP for the entire plant and incorporation of its interface in the process and corporate communication. This means that all system components are combined into just one user interface, so ensuring that operation and programming of the system is especially comfortable and reliable for the user. With the integrated user administration system (audit trail) all operations in the system performed by the user can be recorded and freely definable access rights can be set up which is especially important for the pharmaceutical industry.

Cognex's worldwide sales and service network is a perfect complement to the global marketing strategy of Mettler Toledo ensuring fast support in terms of both hardware and software.

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info@cognex.com
www.cognex.com

Interactive Data Eyeglasses

For car designers, secret agents in the movies and jet fighter pilots, data eyeglasses – also called head-mounted displays, or HMDs for short – are everyday objects. They

transport the wearer into virtual worlds or provide the user with data from the real environment. At present these devices can only display information, but now a group of scientists at Fraunhofer Institute for Photonic Microsystems IPMS is working on a device which incorporates eye tracking – users can influence the content presented by moving their eyes or fixing on certain points in the image. Without having to use any other devices to enter instructions, the wearer can display new content, scroll through the menu or shift picture elements. The Dresden-based researchers have integrated their system's eye tracker and image reproduction on a CMOS chip. This makes the HMDs small, light, easy to manufacture and inexpensive. The chip measuring 19.3 by 17 mm is fitted on the prototype eyeglasses behind the hinge on the temple. From the temple the image on the micro display is projected onto the retina of the user so that it appears to be viewed from a distance of about one meter. The image has to outshine the ambient light to ensure that it can be seen clearly against changing and highly contrasting backgrounds. For this reason the research scientists use OLEDs, organic light-emitting diodes, to produce micro displays of particularly high luminance.

www.iwm.fraunhofer.de

Robotics Conference Worldwide Meeting in Munich

The most important robotics conference worldwide „ISR/Robotik 2010" is taking place for the second time within the framework of Automatica. The participants at the conference, composed of the International Symposium on Robotics 2010 (ISR) and Robotik 2010, will meet at the International Congress Center (ICM) on the grounds of the New Munich Trade Fair Centre June 7 to 9, 2010. Automatica, International Trade Fair for Automation and Mechatronics, will take place in the directly adjacent trade fair halls from June 8 to 11, 2010.

The „Who is Who" of the international robotics community from research and industry will meet in Munich for this double conference: on one hand, to share results related to actual practice, and on the other hand to show the world's greatest range of robotics offers and comprehensive automation solutions at the trade fair.

www.automatica-munich.com

OpteamX Is Exclusive AVT Distributor in Israel

Allied Vision Technologies (AVT) and OpteamX have signed a distribution contract granting OpteamX the rights for the exclusive distribution of AVT digital cameras in Israel from May 2009 on. OpteamX, a leading supplier of machine vision components and solutions with headquarters in Azor near Tel Aviv, Israel, have been successfully selling Prosilica cameras since 2006.

www.alliedvisiontec.com · www.opteamX.com

Mats Gökstorp New EMVA President

New president of the European Machine Vision Association (EMVA) is Dr. Mats Gökstorp (Sick). Mats Gökstorp has been a member of the Executive Committee since the foundation of the EMVA in May 2003 and contributed to its success from the very beginning. He is member of the Management Board of Sick and responsible for the Advanced Industrial Sensors Division which includes the Vision Business Unit. As the EMVA President his focus will be on further developing the industry marketing activities of the EMVA. "The EMVA website, newsletter, market research, standardisation initiatives, and the European Machine Vision Business Conference are the core activities that will support our members to be more successful in this challenging industrial climate," said Mats Gökstorp.

Special thanks go to Gabriele Jansen, who had served as EMVA President in the preceding two terms of office. Gabriele Jansen has initiated a wide range of projects and implemented important national and international tasks. She will carry on her work as a member of the Executive Committee. "Mats is the perfect choice for the EMVA president and I am very much looking forward to working with him and the whole team of the Executive Committee during the next three years," said Gabriele Jansen.

www.emva.org

US-Patent for Robot Milking Application

LMI Technologies has received its first of several worldwide patents for the use of Time of Flight sensors in livestock management from the United States Patent and Trademark Office. The patent comprises details on how a light projection source and a camera having two dimensional array of pixels, each of which is capable of returning time of flight information as well as intensity. This system has the advantage of being compact, light, and not subject to obstruction limitations of other technologies used in robot milking applications. The technology will create significant improvements to yield performance and farm productivity, livestock well-being, enhance reliability, increased speed of farm operations and profitability, and improve product quality in the milking process.

www.lmitechnologies.com

First GigE Vision-validated Software

At the beginning of July 2009, Common Vision Blox (CVB) by Stemmer Imaging was successfully tested by the Automated Imaging Association (AIA) for meeting the validation requirements of the GigE Vision standard. The independent, modular programming library for imaging applications now is the only software product worldwide that was able to take and pass this AIA validation test. During that test session, the AIA also took a close look at the CVB GigE Vision Server to assess its compatibility with the standard. This „software GigE camera" with its freely definable camera properties also met all the technical requirements of the standard.

www.stemmer-imaging.de

+++ +++ +++ +++ +++

Specialised Imaging Ltd. has announced a 60 % increase in sales of its ultra high-speed cameras and systems, designed to acquire images of even the fastest events, to Asian customers over the last 12 months.

Leoni, the leading provider of cable systems to the automotive sector and other industries, has taken over the US company **Valentine Robotics** in full effective July 1, 2009. Valentine Robotics operates in a high growth niche market with its specialisation in programming and commissioning of industrial robots, turn-key solutions for image processing and measuring systems.

YesTech, a subsidiary of **Nordson** Corporation and a leading supplier of automated optical and x-ray inspection systems for the electronics industry, has partnered with **InterLatin** of Mexico to represent YesTech's complete line of AOI and X-Ray products within the region.

Northwire, Technical Cable, has named Michael Conger the company's new president, replacing Mark Kravik, who was president and owner since 1984 and is transitioning to chairman of the board.

Böwe Bell + Howell announced a strategic agreement to integrate their JetVision software technology into the **Lasermax Roll Systems**' WebVision product line for print integrity and quality inspection systems.

Flir Systems, Inc. has acquired the stock of **Salvador Imaging**, Inc., a leading provider of high-performance visible and low light imaging systems, for US$13 million cash.

LMI Technologies announces **Grayhill Inc.** as their vender of choice for highly configurable I/O racks and modules for the maestro product line of machine vision controllers.

+++ +++ +++ +++ +++

Large Decline in NA Vision Market

At the end of the first quarter of 2009, the North American machine vision market experienced its largest year-on-year quarter decline ever – approximately 41 %, according to Nello Zuech, Yardley, PA consultant in machine vision. The economy and associated decline in capital spending throughout all manufacturing industries account for the decline, especially the decline in semiconductor equipment spending still the largest consumer of machine vision. North American machine vision market revenues declined 26 % between the last quarter of 2008 and the first quarter of 2009. The North American machine vision industry revenues from worldwide sales of North American companies declined somewhat more year-over-year – 43 %, while quarter-over-quarter decline was about the same – 26 % as that of the market decline. Clearly this reflects a slump in capital spending throughout the industrial world.

www.vision1.com/vsi

Joint Marketing Agreement with SAP America

Böwe + Howell (BBH) finalized a joint marketing agreement with SAP America, Inc. Through this agreement, the companies will help customers optimize productivity and enhance analysis capabilities of SAP solution deployments. The combination of JetVision, an advanced vision technology from BBH with SAP applications, will help safeguard for customers the quality, integrity and efficiency of manufacturing operations and allow them to further maximize the value of their SAP solutions-based environments.

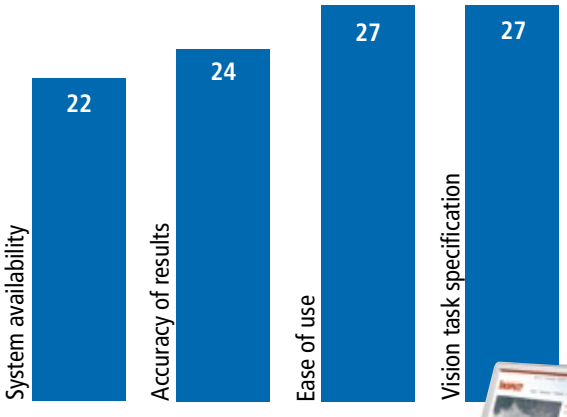
www.bowebellhowell.com

e2v Partners with Pleora

e2v and Pleora Technologies announced a partnership agreement whereby e2v will employ Pleora's iPort eBus Universal and Optima Drivers to communicate with e2v's industrial inspection cameras featuring GigE interfaces. e2v's flagship line of Aviiva line scan industrial cameras will be the first to incorporate Pleora's GigE video connectivity technology. Future GigE e2v line scan cameras will also benefit from Pleora's iPort driver solution. e2v cameras equipped with iPort technology will comply fully with the GigE Vision and GenICam standards.

www.e2v.com

What is the main criterion for the successful use of machine vision in production?



Source: Inspect-Online

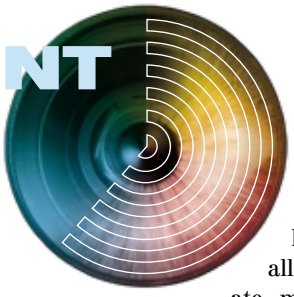
Poll

Calendar

DATE	TOPIC · INFO
07.–10.09.2009 London, UK	**British Machine Vision Conference 2009** The main UK conference on machine vision http://web4.cs.ucl.ac.uk
09.–11.09.2009 Jena, Germany	**DAGM 2009** The 31st annual pattern recognition symposium of DAGM http://www.dagm2009.org
14.–19.09.2009 Munich, Germany	**Drinktec** The world fair for beverage and liquid food http://www.drinktec.com
21.–24.09.2009 Munich, Germany	**Motek** Global trade fair for automation at the heart of European industry http://www.motek-messe.com
29.09.–01.10.2009 Nuremberg, Germany	**FachPack** Trade show for packaging solutions http://www.fachpack.de/en/
06.–08.10.2009 Paris, France	**Vision-Show** Leading trade show in its market in France http://en.mesurexpo.com
21.–22.10.2009 Beijing, China	**Vision China 2009** 6th international machine vision exhibition and conference http://www.visionchinashow.net
03.–05.11.2009 Stuttgart, Germany	**VISION 2009** Leading trade show for machine vision and identification technologies http://www.vision-messe.de
10.–13.11.2009 Munich, Germany	**productronica 2009** Leading international trade fair for innovative electronics production http://productronica.com
24.–26.11.2009 Nuremberg, Germany	**SPS/IPC/Drives 2009** Exhibition for electric automation technology http://www.mesago.de/en/SPS/main.htm
02.–04.12.2009 Yokohama, Japan	**‚09 ITE** International technical exhibition on image technology and equipment http://www.adcom-media.co.jp
02.–05.12.2009 Frankfurt, Germany	**Euromold 2009** World fair for mold making/tooling, design, application development http://www.demat.biz
23.–28.01.2010 San Francisco, USA	**Photonics West 2010** The latest advancements in light-driven research and technologies http://spie.org
16.–17.04.2010 Istanbul, Turkey	**EMVA European Machine Vision Business Conference 2010** Annual business conference of the European Machine Vision Association http://www.emva.org

Find these and more events with detailed information at **http://www.inspect-online.com/en/events**

VIEWPOINT



The Future Lies in Openness

As a developer of intelligent cameras, I am aware of the many problems that suppliers and users of machine vision solutions are facing. Once you have assembled suitable hardware components, development tools must be chosen. This is where various license models, some of which are very cost-intensive, clash with interoperability problems, which means that software development can turn into a very tedious task. From the user's point of view, a development platform which requires no license fees and which is compatible with all hardware components would therefore be highly desirable. Solutions developed by means of such a platform could be used with intelligent cameras and PC-based systems alike, without regard to proprietary features. Such a platform, which would ensure independence, flexibility and not least safety for users, could be implemented by means of an open source model. This is made possible by OpenCV, an open program library originally developed by Intel, which we have been successfully using with our products for some time now. OpenCV was released under the BSD open source license, which allows users and manufacturers to become acquainted with the library without complicated license agreements, and to adapt it to their applications as required.

I can counter the accusation of giving away know-how free of charge: in our experience, customers will continue to pay for good, safe products, since professional users, who are faced with time-to-market pressure, require additional software and services for the implementation and maintenance of new products. Moreover, software with a BSD license can be used as a basis for new products by other service providers. They can sell these new products without disclosing the source code of their own adaptations, as long as they do not remove the copyright notice from the original source code.

Additionally, open software facilitates the implementation of solutions, which in turn increases hardware component sales, allowing users to easily create modular image processing solutions. Protecting proprietary software products, which will sooner or later surface as illegal versions in any case, does not make sense in my opinion. Last but not least, open software solutions also facilitate the long-term maintenance and support of existing solutions. Today, problems may arise when software support ceases after a hardware component is discontinued. With open source solutions, customers will be able to easily exchange components and find service providers who can adapt their open software.

Successful approaches to openness can already be observed in other industry branches. The Powerlink user organization EPSG, which cooperates with the Open Source Automation Development Lab (OSADL), for example, practices a successful open source policy. The Linux world has demonstrated that openness and transparence are the basis for quick, reliable quality control: any occurring problems can be found and fixed by the community within a very short time. Of course, this can only happen when the source code is available to all, and requires the joint efforts of many. Therefore, I would like to convince as many parties as possible to join the OpenCV community – I will be happy to answer any enquiries.

The more we become active in the open source world, the earlier open software solutions will be attractive and profitable for all sides.

Michael Engel
CEO Vision Components
www.vision-components.com

Comparing Apples to Oranges

Self-service Scales auto-detect Fruits and Vegetables with USB Cameras

Comparing apples and oranges, unlike in the proverb this is possible – at least in supermarkets and on the basis of color. There, the machine vision system of self-service scales auto-detects and distinguishes fruits and vegetables with an integrated USB camera. The self-service scales offer clients four alternatives to choose. This system has been developed for the shoppers' convenience: To find the right button among dozens of different types of products is a thing of the past.

Superstores offer more than only apples and oranges. Consumers require increasingly exotic products like papayas, plantains or lemon grass. This multifarious range of fresh produces has one disadvantage: Self-service scales with dozens of buttons, where it is difficult to find the right sort. Often the shopper needs time to search the right button or he is forced to memorize a code up to four digits. The German company Mettler Toledo helps with special self-service scales, the version UC3-GTT-P, where a compact, integrated USB camera auto-detects individual products. The UC3 scale series are PC-based and vested with touch screens. The camera produced by IDS Imaging Development System is only about 3.5 cm in size. The board-level version of the USB uEye LE camera is hidden inside a curved metal arm that is mounted to the scale's screen. This way the camera points directly at the weighing plate on which the products are placed.

"Recognition in Progress"

As soon as a client places weight on the scale, he will be informed on the operating panel: "Recognition in progress" and the analysis process starts. First, the machine vision system checks whether the image captured by the camera changes, for example because the user's hand is in the field of view. As soon as the image remains still, the system starts analyzing. After a second four possible matches are presented for selection in colored fields. The consumer chooses now the desired type and the scale prints the label.

The image analysis is based on color, the inspection criterion. The colors detected in the product on the scale are compared with a stored list of colors that are assigned to the individual types of fruit and vegetable. The system analyzes not just single colors, also combinations of colors are identified. This way, for example, a specific combination of red, green and yellow could be recognized as "mixed peppers". The combined analysis also helps distinguishing products of similar color, such as lemons and bananas. Characteristics like the shape and texture are additionally evaluated. But the use of plastic bags often complicates analyzing these features. A fully automatic system cannot be implemented due to disturbance factors, as highly fluctuating light conditions or covered areas in the image.

Mettler Toledo developed the algorithms in cooperation with the Fraunhofer Institute for Information and Data Processing. "The greatest challenge was the actual definition and weighting of the product characteristics," says product manager Klaus Weber.

The IDS USB uEye LE camera is hidden inside a curved metal arm that is mounted to the scale's screen

The uEye Camera Family

The USB uEye LE series is a family of compact and cost-effective USB 2.0 cameras with CMOS sensors and resolutions from WVGA to 5 MP. Besides board-level versions with M12 or M14 threaded lenses, IDS also provides a housing version for the USB uEye LE.

The uEye camera range features CMOS and CCD models with a rugged metal housing and USB 2.0 or GigE interface. The extensive uEye Software Development Kit (SDK) for Windows and Linux is available for free and is compatible with all uEye camera drivers. The uEye SDK includes over 20 demo applications for camera integration and image acquisition as well as the source code in C++, C# and VB. The software bundle provides an ActiveX component, interfaces for DirectShow/WDM, TWAIN and 3rd party drivers for most popular machine vision software. The cameras of the uEye LE series support the new GenICam software standard.

▲ The compact USB camera auto-detects the products on the scale

▲ The USB uEye LE amera series offers high-performance CMOS sensors in a compact design

Detecting Colors Reliably

When selecting the camera, the size, the USB 2.0 connection and the color quality were at the top of the requirements list. The engineers from Mettler Toledo opted for the UI-1226LE-C, a model from the USB uEye LE camera series from IDS. The light-sensitive CMOS color sensor of the board-level camera captures up to 87 frames per second at the full 752 x 480 pixel resolution. The uEye's automatic white balance works reliably even against the blue background of the scale.

The second essential factor was the camera's software integration. Depending on the customer's specifications, Mettler Toledo installs either a Linux-based or a Windows-based operating system on the scale's integrated PC. "The fact that the machine vision specialist IDS is located not far away from Mettler Toledo was a further advantage," explains Walter Grom, the engineer in charge of the project. During the development stage, he visited IDS a couple of times to inspect the quality of production on site and discuss various customizations of the camera hardware. "It was important to us to get a good impression of the quality and reliability of the camera supplier," adds product manager Klaus Weber.

A Successful Combination

In Germany, the combination of precision scale and industrial camera is already in use in over 300 stores of a major food retailing chain. Other retailers in Germany and Europe have also started using the system and are planning to expand usage company-wide, as well.

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We've researched the Web for you and found this:

http://www.inspect-online.com

■ We made good use of the summer and enhanced our website with company news, product information, white papers, webcasts, polls, buyers guide, event calendar, job search – in English and German language, both.

http://www.freepatentsonline.com

■ One of the most powerful, fastest and easiest patent search engines on the web targeted at European, North American and Japanese patents and applications.

http://dict.leo.org

■ This open source dictionary is unbeaten for the quick search of English-German/German-English equivalents. Very helpful are also the translation application discussions between the users.

http://gigapan.org

■ Gigapan provides great stitched panorama images >1 Gigapixel with awesome quality in the details. The images are presented with an easy-to-use interface for the search of the needle in the haystack. To get an impression just take a look at the skyline of San Francisco taken from Yerba Buena with 105 pictures in total, and you can clearly see every single turn of Lombard Street.

https://www.cia.gov/library/publications/the-world-factbook

■ That Azerbaijan was estimated to be home to 8,238,672 inhabitants in July 2009, or that the capital of Burkina Faso is named Ouagadougou, and that Liechtenstein in 2007 had the highest GDP per capita at 118,000 US$ we get to know from the CIA World Fact Book.

http://cordis.europa.eu

■ All relevant information about the European funding program FP7 is found here. FP7 is short for the Seventh Framework Programme for Research and Technological Development and is the EU's main instrument for funding research in Europe between 2007 and 2013.

http://www.youtube.com/watch?v=VpAuDrs5ocg

■ More often than not we have heard that print is dead, and if not yet it is at least megaout, however. This YouTube clip will convince you otherwise for good … Print is alive!

Feel free to send us your online faves to contact@inspect-online.com

Vision 2009

Messe Stuttgart Announces Positive Signs

200 exhibitors have already booked their stands for the Vision 2009. "This corresponds with the number of registrations at the same time in 2008. We are therefore optimistic that around 290 exhibitors will again take part in the trade fair when it starts on November 3rd, 2009," reports Thomas Walter, Division Manager for Industry and Technology of Messe Stuttgart. These good omens in difficult economic times account for the standing of the Vision. Among experts the Vision is long since considered as the leading international trade show for machine vision and identification technologies.

Thomas Walter
Division Manager
Industry & Technology

As in previous years exhibitors show their current developments, products and systems in machine vision and optical measurement technologies in the halls 4 and 6 of the New Stuttgart Trade Fair Center. For the first time there will be a Vision Integration Area at the trade fair: this concept provides system integrators with the opportunity to present their solutions from an attractive and clearly demarcated area and thus optimally appeal to the end users. Florian Niethammer, Project Manager of Messe Stuttgart, announced that the aim of the Integration Area is to focus on applications and solutions to a greater extent. In a successful system solution there is need for more than merely an adequate selection and integration of components: Process know-how and knowledge of system peripherals, interfaces and environmental conditions, extensive expert knowledge and experience in project management for machine vision results in highly efficient and reliable turn-key systems. The Vision Integration Area is sponsored by INSPECT.

Trends 2009

According to Messe Stuttgart infrared cameras are amongst this year's trends in the field of vision components. In the past, these cameras were used for monitoring, research or military purposes. Today infrared cameras are on the advance in industrial production processes and for quality inspections. They inspect printed circuit boards, e.g., or monitor welding and bonding processes.

There are numerous innovations in the field of 3D machine vision as well: cameras which provide accurate distance information with every grey value image, software libraries specialized in 3D analyses or triangulation, stereoscopic and photogrammetric approaches in system solutions for robot guidance and quality control. The INSPECT will chair a panel discussion on this topic on the second day of the trade show. On November 4th from 2 p m to 3 p m renowned experts will discuss about "All you ever wanted to know about 3D-Technologies, Applications, Benefits."

This year again, an inherent part of Vision is the presentation forum "Industrial Vision Days" which is organized by the VDMA (Verband Deutscher Maschinen- und Anlagenbauer), the German Engineering Federation. The Industrial Vision Days offer manufacturers, users and scientists a platform to present product developments, research findings and application knowledge. You will get the detailed program of the three days series in the next issue of INSPECT.

The Vision exhibits even more highlights, e.g. the "INSPECT Discovery Tour Vision 2009", the trainings of the Vision Academy or the presentation of the 17th Award for Applied Machine Vision. Discover the trade fair yourself; from November 3rd to November 5th, 2009 at the New Stuttgart Trade Fair Centre, right next to Stuttgart airport.

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Frozen in Time

Image Processing Basics: Moving Objects

A common situation in industrial image processing is to inspect moving objects in a production line. Parts on a conveyor belt, e.g., may drift through the field of view of the camera with constant velocity. Even moderate velocities will result in considerable smear of edges in the image due to the integration time of a standard camera. Lighting and image capture must be carefully triggered to achieve sharp images for proper image processing.

Smear

Transport velocities of several meters per second are quite common when handling parts in a production line. Mail processing or web inspection may well be performed at velocities of 10 m/s. Parts are transported by means of conveyor belts, slides or in free fall, and circumstances call for image capture while the objects are in motion. Figure 1 gives an example of the effects caused by moving objects. A colored chocolate lentil with a diameter of about 1 cm is moving from the right to the left, and the image has been captured with a 50 Hz interlaced camera. With this type of camera, the even field has a delay of 20 ms with respect to the odd field. The edge of the object in the first, third, fifth and so on line of the odd field is considerably shifted with respect to the position in the second, fourth, sixths and so on line of the even field. The edges are frayed like the teeth of a comb due to the delay between the fields. With progressive scan cameras, there are no fields, but only full frames, and the comb-effect can not occur. Nevertheless, edges will be smeared even with progressive scan cameras. Figure 2 shows an example, the so-called hummingbird-moth, a butterfly which is able to hover in front of a blossom by flapping its wings with an unusually high frequency and drinking nectar with its tube-like trunk. The region of the wings is only slightly tinted and completely blurred due to the relatively long integration time of the image.

Even at a transport velocity of 1 m/s an object will be shifted by 1 mm along the direction of motion within 1 ms. A progressive scan camera with a frame rate of 50 Hz, which may nowadays well be considered to be a standard in industrial image processing, features an integration time of 20 ms. An object with a velocity of 1 m/s will thus move through a distance of 20 mm during the integration time. In an image captured under these conditions, an edge will be smeared by 20 mm along the direction of motion. At 10 m/s, the smear will amount to 200 mm. Most image processing applications will break down under these circumstances. With moving objects, much smaller integration time intervals must be chosen to get proper images. The value for the acceptable time interval depends upon the transport-velocity and upon the smear which can be tolerated. In general, the pixel resolution of a camera will be compromised when the smear becomes larger than a pixel. Thus, it seems reasonable to reduce the smear to the dimension of a pixel or below. As an example, let us assume a

field of view of b = 100 mm which shall be inspected by a camera with a pixel resolution of 1,000 x 1,000 pixels at a transport-velocity of v =1 m/s in the direction of the x-axis. The pixel resolution in the field of view will thus be dx = b/N = 100 mm/1,000 pxl, which amounts to 0.1 mm/pxl. In order to reduce the smear below dx = 0.1 mm, the integration time interval has to be smaller than dt = dx/v = 0.1 mm/(1 mm/ms) = 0.1 ms, that is 100 µs or 1/10,000 s. In principle, there are two simple methods to implement these image capture intervals: the electronic shutter or strobe-lighting.

Electronic Shutter

The principle of an electronic shutter is depicted in figure 3. A standard camera captures images at a constant frame rate of 50 Hz, e.g. With a progressive scan camera, the charge generated by the incoming light will be accumulated within 20 ms in every detector pixel and read out at the end of the integration time period. The detector sites are empty, and the charges for the next frame may be accumulated. Likewise, a 50 Hz progressive scan camera with electronic shutter will produce a frame every 20 ms. The integration of the charges, however, will be modified: after 19 ms, e.g., the accumulated charges will be drained by a single pulse for all pixels simultaneously, and the array will accumulate charges for the remaining time interval, 1 ms in this case. The detector will then be read out at the end of the standard integration period, producing an image signal corresponding to an integration time interval of just 1 ms. The effective integration time can thus be modified by controlling the drain pulse without need to change the read out timing. An effective integration time of 100 µs as demanded in the example given above may easily be achieved with state-of-the-art cameras. The integration time interval, however, always will be the final part of the regular frame period. Unfortunately, the parts in a production line usually will not be delivered at a constant rate, but will appear asynchronously in the field of view of the camera. Most applications will therefore use a photo sensor to detect incoming parts. The next frame may then be used for image capture. If the sensor is triggered near the end of the frame period, the effective integration time interval will follow within a short time interval after the trigger signal. If the sensor is triggered just after the beginning of a new frame period, there will be a delay of close to 20 ms between the effective image capture provided by the electronic shutter and the trigger signal. Trigger signal and effective image capture may thus suffer a time delay between nearly 20 ms and no delay at all, depending upon the phase of the frame period at the time when the trigger occurs. Within 20 ms, however, an object will move through a distance of 20 mm at a velocity of 1 m/s and by 200 mm at 10 m/s. The image will be sharp, but the position of the object within the field of view will vary by up to 20 mm or even 200 mm, respectively. With a field of view of 100 mm, this “jitter” may be acceptable, but the image processing algorithm has to take care of this situation. With smaller fields of view and higher velocities, however, the object may well be already far beyond the field of view when the electronic shutter becomes active. Thus, the combination of a camera running at a standard frame rate with random phase and an electronic shutter will

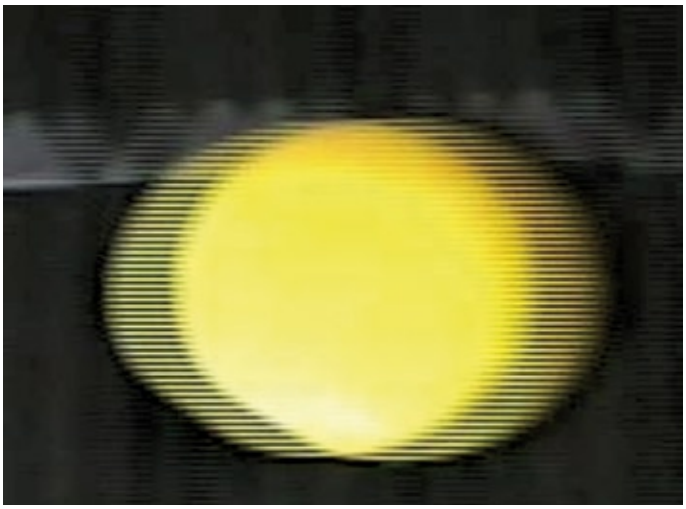

Fig. 1: An object moving from the right to the left, captured with a 50 Hz interlaced camera. The time delay between the odd and the even field causes the comb-like fraying of the edges along the direction of motion.

Fig. 2: Smear in an image captured by a progressive scan camera, to be seen in the region of the fast moving wings of the Hummingbird-moth; integration-time: 25 ms.

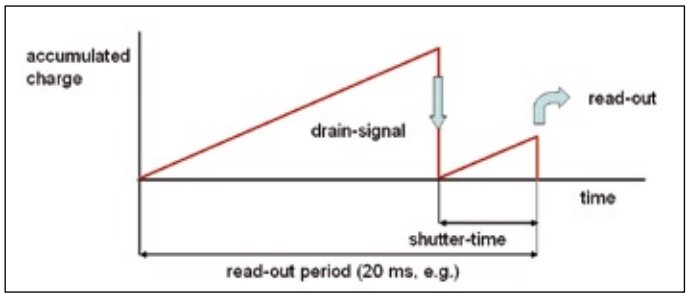

Fig. 3: Principle of the electronic shutter

generally not be the best recommendation for image capture with moving objects. One possible alternative are cameras with a restart/reset-feature. These cameras provide a trigger input suitable to cancel the current frame period immediately, to drain the charges accumulated and to instantly begin with the next frame period. In combination with a photo sensor this feature will result in a constant time delay between the reset signal and the time when the electronic shutter becomes active. With constant transport velocity, the photo sensor can be placed at a defined distance from the field of view of the camera such that the object will move precisely through this distance during the time delay between trigger and the effective integration time period. The object will thus be captured in a sharp image and will always appear at the same position within the field of view. As an alternative cameras with asynchronous shuttering are available. With these cameras the accumulated charge is drained immediately after the trigger pulse, directly followed by the beginning of the desired integration time interval. At the end of this time interval, the image is read out. These cameras are thus not restricted to a fixed frame rate, their image capture timing is asynchronous. Since the integration time period now begins immediately after the trigger signal, however, a time delay of the trigger signal may become necessary, depending upon whether the photo sensor triggers with the leading or the falling edge of the object and upon the distance between the photo sensor and the field of view.

Strobe-lighting

An electronic shutter usually will be used in combination with a DC-lighting device. In the example given above, however, an effective integration time of 100 µs will utilize only about 0.5 % of the available light intensity compared to the standard integration time of 20 ms. As a consequence, the illumination intensity has to be increased by a factor 200 to get image signals comparable to the situation without electronic shutter. A more efficient solution in this situation will be a strobe-lighting like an LED-device, e.g., with a defined pulse length. In the context of the example given above, a strobe time of 100 µs will have the same effect as an electronic shutter with 100 µs integration time interval. Provided that the ambient light level is sufficiently low or may be shielded, the movement of the object will be "frozen" by the LED-strobe, since only within the LED-pulse there will be enough light scattered back from the object to the detector to produce a significant image signal. The camera may be sensitive during the full frame period, and the LED-strobe will form the image randomly at some time during the standard integration time period. As with the electronic shutter, the timing scheme of the strobe illumination should also be triggered by the photo sensor, which detects the incoming object. This signal triggers the restart/reset of the camera und produces the trigger signal for the strobe, eventually after a defined time delay to allow for the movement of the object into the field of view. By this method, the pulse width of the strobe-lighting defines the smear in the image due to the movement of the object, and the time delay between the strobe pulse and the trigger signal at the photo sensor defines the position of the object in the image. In order to be flexible for different requirements, a special additional I/O-board may be helpful, which provides trigger signals for the camera reset and for the strobe unit, a programmable delay and shaping of the trigger signal from the photo sensor with regard to level, polarity and rise time. Convenient frame grabbers with these features are available.

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Is the Discussion on Digital Interfaces Done Yet?

Interview with Vlad Tucakov, Director of Sales and Marketing, Point Grey Research

The digital camera interface: an evergreen for discussion. We as well have covered this topic several times already and also have published surveys among vendors and users. The question if this discussion is likely to come to an end any time soon and what that end might be, was also pondered at this year´s EMVA conference in Dublin. Vlad Tucakov, Point Grey, gave a widely acclaimed presentation on the topic. We spoke with Vlad afterwards.

INSPECT: Vlad, it feels like the machine vision industry has been debating over camera interfaces forever. Do you recall when and why this actually started?

V. Tucakov: It all began with the breakdown of the traditional model for image capture, which primarily consisted of an analog camera connected to a frame grabber. With the advent of new digital interfaces, such as FireWire and USB, frame grabbers either became unnecessary or could be replaced by much simpler and less expensive interface cards.

At the same time, camera vendors were facing demand from customers for software support, which some of the larger, more traditional camera manufacturers were unable or unwilling to provide. This opened the door for smaller companies to enter the market. These companies defined themselves by the interface they supported, which meant that to be successful they had to ensure the interface was well-recognized, standardized and accepted. At that point the debate truly began, with each company making an argument as to why the interface they supported was the best for machine vision.

Which interfaces are still in the running for vision applications and how do they differ?

V. Tucakov: The main interfaces that customers have to choose from have not changed substantially over the last few years, and they each have their strengths and limitations when it comes to things like bandwidth, latency, cable length, multiple camera support, and so on.

Of the digital interfaces, CameraLink is still the bandwidth king at around 6 Gbit/s with a full configuration, but has limited support for multiple cameras and requires a frame grabber that can often be costly. IEEE 1394b (FireWire) can run at 800 Mbit/s with guaranteed bandwidth and has excellent reliability, but requires repeaters to run over distances longer

than about 10 m. GigE Vision supports 1 Gbit/s data rates and can be run over 100 m of inexpensive Cat5e cable, but has some latency and quality of service issues. And last but not least is USB 2.0, which has lower bandwidth than the rest at around 480 Mbit/s, but is extremely cost-effective, easy to use, and supported on virtually every PC.

What I also find interesting is that many in the industry have been predicting the demise of analog for quite some time. What we're seeing, however, is that it is still in high demand for lots of applications and in various markets. Analog cameras are cheap, simple to use, and were the original inspiration for the popular "sugar cube" form factor seen with many digital cameras. I think it will be many years before we see them go away completely.

What would be required of an interface to become a clear winner of the interface race?

V. Tucakov: Obviously if one interface can cover the size of the camera, bandwidth, cable length, price etc., it would be the clear technical winner, but I think customer requirements are too diverse to be met by just one interface. In my experience, it is often what the interface does not do that makes the decision, rather than what it does do. For example, in many semiconductor and electronics applications, a cross-section size of 29 mm x 29 mm is an important requirement because one of the most popular analog camera types used in these applications is the "sugar cube" style camera I mentioned earlier. I would guess that 75 % of the units sold in the world are this size. Currently there is not one Gigabit Ethernet camera that fits this requirement. On the other hand, Gigabit Ethernet cameras address the cable length issue "out of the box", while all other digital interfaces require some sort of a repeater to achieve cable lengths up to 100 m.

It is unlikely we will ever see the type of "format wars" that we have seen with other technologies, like Betamax versus VHS, where just one technology emerges triumphant. That said, we will probably see attrition of market share of some of the digital interfaces over time, as we have seen with analog. I expect some of the existing interfaces will disappear over the years, either because completely different interfaces supplanted them or because newer versions made them obsolete.

Technical merits aside, what other factors play into the interface debate?

V. Tucakov: One factor is the interests that the market leaders pursue. If a particular interface erodes their margin, or if it makes it easier for other companies to compete with them, then the interface may not be supported. Similarly, you can have a sales force that decides one interface is better, or yields higher commissions, than another. These types of factors are not just limited to camera

manufacturers, but can extend to vision software and other component suppliers.

Another aspect is the risk that end users are willing to take. Some markets are very conservative and will use technology that they trust, rather than using a technology that appears from their point of view to be the better, faster or less expensive one. Machine vision is also a relatively small market compared to many other industry sectors. As such, we are highly dependent on consumer market developments and the technologies that will be successful in that arena.

What role has marketing played in the interface debate?

V. Tucakov: Marketing initiatives by camera vendors, various associations and the media have certainly contributed to the hype. But we need to keep in mind that just because there are many companies that offer cameras with an interface that is touted to be the "industry standard", that does not mean the interface is well accepted by the customer or that it is particularly good for a specific application.

In the end it all comes down to the customer and their application. Choosing the interface based on the technical merits of the application and not on the number of headlines it generates should be key in the customer's decision making process.

What new interfaces are emerging and what are their key features?

V. Tucakov: The development of new interfaces or advances in existing interface technology is being driven by a number of things. The industry is seeing a marked increase in the availability of faster, higher resolution image sensors. Most CCD manufacturers provide multi-tap sensors to achieve faster frame rates, and there are a number of CMOS imagers coming out that provide very high quality images at high speeds. There is more demand from customers for better reliability, ease of integration and use, and a migration path for future retrofits. Technology developments in the consumer market will also play an important part.

New advances in FireWire technology, specifically 1394b S1600 and S3200, will increase bandwidth up to 1.6 Gbit/s and 3.2 Gbit/s respectively without any change to the cables or connectors and minimal software changes, making it easy to integrate higher data rate cameras into existing applications. 10GigE will increase bandwidth to 10 Gbit/s, but may run into power, CPU load, and hardware cost issues. There are also proposals to increase Camera Link bandwidth, with one proposal allowing data rates up to 25 Gbit/s over 20 m of standard coaxial cable. Power over CameraLink Lite (PoCL-Lite) is now part of the standard and allows the manufacture of smaller, low-cost digital cameras. USB 3.0 will be about ten times faster than USB 2.0 at around 5 Gbit/s, will be backward-compatible with USB 2.0, and will address many of the limitations with the existing technology. It will have almost the same connector footprint as USB 2.0, provide more power over the cable, and reduce the software overhead from polling.

Do you think the industry will see cameras with other interfaces like PCIe or SATA?

V. Tucakov: These interfaces are largely driven by consumer markets, and will probably not have a large use in the vision industry. PCI Express (PCIe) and Serial ATA (SATA) are not peripheral technologies, and so do not lend themselves well to cameras. The High Definition Serial Data Interface (HD-SDI) and HDMI are very well-suited for visualization applications, but the availability and cost of image acquisition hardware will make them a more exotic choice for vision applications. That said, I wouldn't be surprised to see some of these interfaces make their way onto machine vision-style cameras.

What impact will these new interfaces have on the vision industry?

V. Tucakov: I think that some of the CameraLink market share in the sub-5 Gbit/s segment will move to other interfaces, although it will still be dominant in those segments that require upward of 5 Gbit/s.

USB 3.0 will also become an important camera interface and is expected to play a big role in the next few years; it even has the potential to be perceived as the "ideal" interface. USB 3.0 promises a major leap forward in transfer speeds and capability. The combination of higher bandwidth, excellent reliability, low cost, and easy integration will be the primary advantages of USB 3.0 and could open up new vision applications, especially in non-industrial markets where we have already seen USB 2.0 gain widespread acceptance.

What is your prediction for the interface race over the next five years?

V. Tucakov: The price of cameras and components will go down, and demand for the "standard" VGA or XGA cameras that run between 30 and 60 FPS will move to 2 to 5 megapixel cameras that run at similar or higher frame rates. The pace of technological innovation will not slow down and history will probably repeat itself. The migration of analog to digital interfaces started in the late 90s, and we will likely see some cross-migration between digital interfaces. I think we will stop talking about "analog to digital conversion" and focus more on "digital to digital" conversion.

There is one thing I am certain of: the discussion on interfaces will not end anytime soon.

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Three Steps to Full Parameterization

Coating Inspection of Injection-molded Parts Set up by Intuition

High grade surfaces of control elements are often an important part of design concepts and should transport the impression of a likewise high-grade product. At the same time, these products have to be efficiently produced in large quantities. This applies also to injection-molded caps of switches and knobs, the surface of which will frequently be upgraded by lacquer. Diverse defects, however, may occur during coating with lacquer which all have to be sorted out by only one inspection station – but which, unfortunately, will hardly be recognized from one single view. A true challenge, also for the set-up of parameters for the inspection system.

Due to their great flexibility, the P400 machine vision systems (here, P400MD) are also suitable for complex tasks

Modern vision systems, like Panasonic's PC-based P400 series of appliances, are quite capable of detecting also those defects that are hard to find by the naked eye. The clear structure of the P400 software is of great help in assigning the necessary parameters, as its analyzing tools are designed basing on each other. With a little deliberation a reliable solution for surface inspection can be found in a likewise systematic manner. Its advantage: The necessary train of thought may be directly deducted from the practice of production and may be transferred into assigning suitable parameters.

Optical Enhancement

Filtering

Detection

Optical Enhancement

For the inspection of injection-molded caps, the surface features to be detected are optically enhanced in a first step: the parts are lighted laterally so that they appear light on one side and increasingly dark on the other. This way, blisters will cast a shadow with soft transition into the surrounding. The plastic cap has a rough basic structure giving it a matt look. The entire lighting is composed in the following way (in the sequence of its extension): Lateral lighting decreases across the entire cap. However, the extension of the blister, unidirectionally, reaches about one tenth of the surface. Finally, the rough surface structure changes its grey-value in less than one hundredth of the extension of the cap. See example in figure 1.

In recognizing the lacquer blister, the following line of thought is of help: The different extensions of said surface properties show up as grey-value changes, occurring with different frequencies, superposed on each other and thus as a whole giving the complete image. This is shown by figure 2. It shows a simplified grey-value profile, resulting from the superposition of the lateral lighting, a lacquer blister, and a rough lacquer surface. The principle of isolating the lacquer blister in the image consists of reconstructing the blue curve marked "blister" from the grey-value profile.

Grey-value Filters and Dynamic Thresholds

Reconstructing the curve requires two steps. First, the rough surface needs to be suppressed. Here, the P400 software employed offers suitable grey-value filters. The human observer, too, will more easily recognize the lacquer blister in the thus filtered image of figure 3. Figure 4 shows the grey-value profile without disturbance by the lacquer coating. By the way, one can easily simulate the effect of suppressing disturbing details by a blinking of the eyes. By blinking of the eyes, too, the image will become less sharp and the lacquer blister will become visually more distinct.

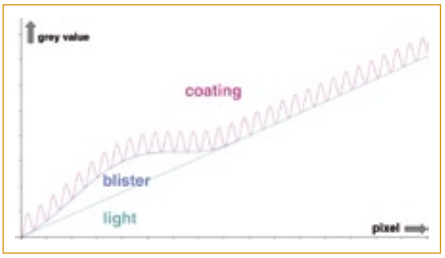

Fig. 2: Superposition of lateral lighting, a lacquer blister and the rough lacquer surface

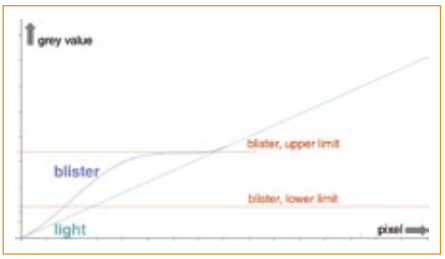

Fig. 4: Lacquer blister, shown as grey-value profile with lacquer coating suppressed

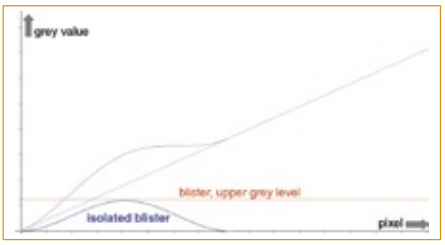

Fig. 5: A dynamic grey-value threshold can isolate the grey-value course of the lacquer blister

Remains the second step, by which to compensate the effect of the lateral lighting. The smoothed grey-value profile shows that the lacquer blister may not be segmented by a static, i.e. fixed for the entire image, grey-value threshold. This is prevented by the ascending average grey-value curve from one side of the cap to the other. A uniform lighting (e.g. from above) is of course not a solution, because the blister will then not cast a shadow and is not recognizable at all. So the tapered grey-value distribution along the cap needs to be suppressed.

Here, the P400 software offers a tool that is as intuitive as it is efficient, bringing the solution of the problem. By a dynamic grey-value threshold, the decreasing grey-value course can be compensated over the entire cap width. This is shown schematically in figure 5. The result of the complete blister recognition process can be seen in figure 6.

Result with Few Steps of Parameterization

The advantage of the procedure described is evident. The line of thought as to how the defect to be detected comes into being and what it causes within the image, can easily be followed within the P400 software by few steps of parameterization. The task of assigning parameters thus may be implemented logically and quickly by the three steps of "feature detection" – "filtering of image" – "dynamic thresholding".

The present example of an application demonstrates how an inspection task that may look complex in the beginning can be broken up into partial tasks by practical considerations. Employing the intuition-operated P400 imaging software, parameters can be assigned in solving these partial tasks, thus resulting in a sturdy overall solution. As part of the process, image filters will be used here in a quite practical and immediate application. The P400 software is equipped with numerous other image filters, which will facilitate likewise useful first-step procedures for quite a number of tasks.

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Determining surface quality by means of visual inspection is required when the assured properties of technical and decorative surfaces cannot be ensured by the manufacturing process alone. However, visual inspections are labor-intensive, subject to fluctuations and can only be applied uniformly in different locations with in-depth training. Streamlining pressures, the objective of zero-defect production and achieving identical standards of quality at different locations motivates the automation of visual inspection in production across all industries.

Mirrored Quality

Deflectometry Opens up Broad Field for Surface Inspection

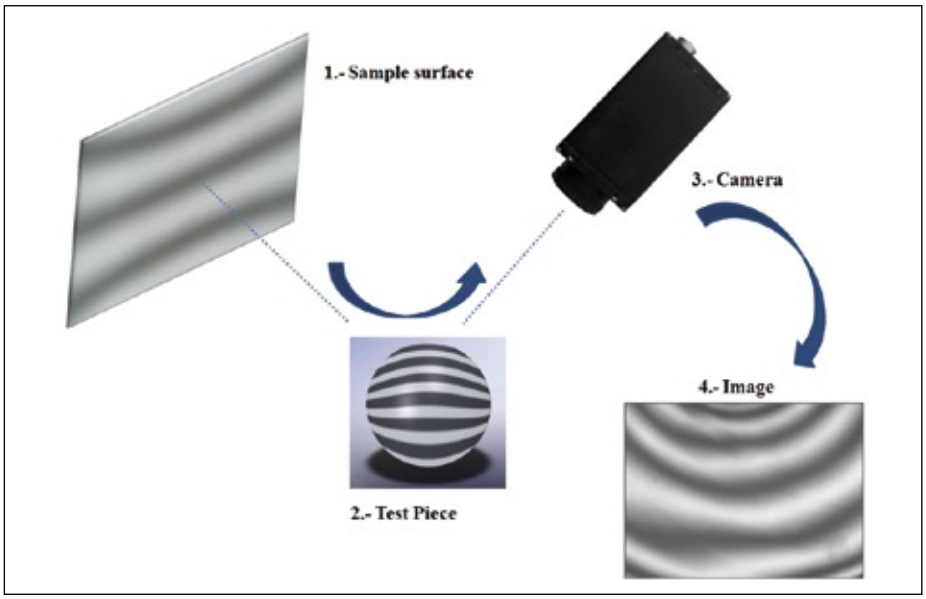
Carl Zeiss aims to support this trend with the development of a product for the automated inspection of surface qualities. The development target has been to cover a wide variety of applications at the operating conditions prevalent in a production environment with only one measuring method. This method must account for both, a wide range of surfaces, some with a high level of gloss, and the various geometries of the inspected parts while delivering reliable and reproducible results.

Analog to Visual Inspection

An ideal method to meet these requirements is the so-called deflectometry. The fundamental set-up of the procedure is comprised of a camera and a pattern surface. The camera, the part to be inspected and the pattern surface are arranged in a way that the pattern surface is reflected on the part from the camera's point of view. In accordance with the law of reflection, the reflection of the pattern surface is distorted according to the surface shape. This method is strongly based on the approach a visual inspector would choose, also making use of the reflections on the surface to judge the surface quality.

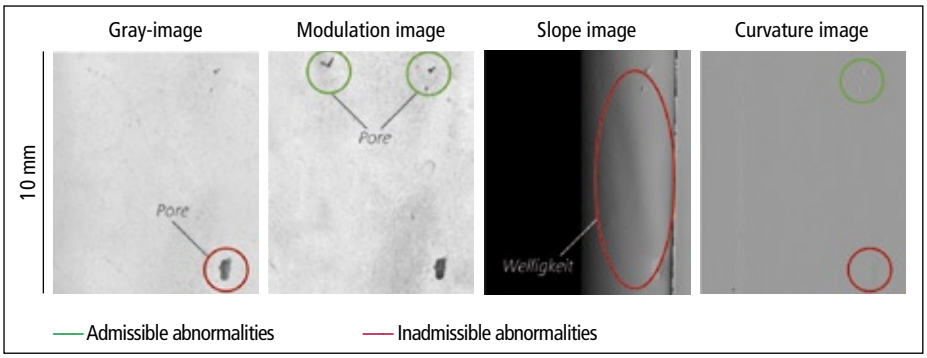
Sinusoidal fringes combined with a phase-shifting procedure, also known in interferometry and fringe projection, have proven effective as a test pattern. The key benefit here is the generation of multiple information channels for image processing. Unlike standard greylevel-image methods, this procedure provides more stability and higher recognition performance.

The illumination unit creates a phase-shifted fringe pattern in several evenly-



Basic set up phase-shifting deflectometry

spaced steps. After each step an image is acquired of the inspected part, i.e. a brightness value is determined for each object point and step. These equidistant probing values of the sinusoidal pattern enable the calculation of the phase position of the fringes and thus determine at which location of the pattern surface the reflection is generated. The orientation of the camera's visual line and the known location on the pattern surface thus determine the direction of the surface normals which describes the inclination of the surface.



Performance of the method, showcased on an Aluminum surface

Three Information Channels

In the first information channel, this leads to a "slope image" created point by point, which provides in-depth information for numerous surface defects such as dents, blisters and runs. From the slope image, a „curvature image" is created by differentiation, in which small geometric defects with pronounced edges, like cavities, pits, notches and scratches, are easily visible.

The second information channel – the "modulation image" – shows how strongly the sinusoidal oscillation occurs at a certain point and represents the local gloss level of a surface. This mode delivers important information on matte areas such as those resulting from dirt, scratches and coating defects.

The third information channel at last – the greylevel image – exhibits almost no noise as a result of its synthesis from the initial phase-shifted images. Furthermore, a special configuration of the illumination unit provides a very homogeneous illumination of the images, even in critical edge areas of curved surfaces.

Dynamic Fringe Patterns

For the inspection of a wide range of surfaces with different gloss properties, the use of sinusoidal fringes offers another key benefit: even in cases where the surface of the inspected part does not reflect perfectly, but exhibits more or less wide scattering beams, the sine fringes might be less pronounced but their signal character does not change. As a result, they can be used for turned, blasted and ground metal surfaces in addition to typical "shiners" such as painted, chromed and plastic surfaces.

The pattern surface including the pattern generation is a determining component of a deflectometry setup. Flexible deployment for a wide range of different parts requires the possibility to dynamically change the patterns. Since the inclination of a surface has two degrees of freedom, two recording sequences with patterns rotated at 90° are used. High light intensity guarantees good illumination of the images even with line scan cameras featuring short exposure times. LED arrays were selected as the illumination unit for pattern generation thanks to their flexibility, brightness and long life-cycle.

Material	Processing/Application
Metal machined	turned
	polished
	blasted
	ground
	brushed
Metal coated	galvanized
	pressed
	anodized
	powder coated
Plastic	untreated
	painted
	coated
Ceramic	industrial
	medical
	decorative

Application areas for phase-shifting deflectometry

Images are captured using the CCD or CMOS cameras common in industrial image processing. Good linearity is important in the method employed; otherwise phase calculation using several images can result in inaccuracies. To synchronize image acquisition at changing patterns, the cameras need to be remotely triggered. The scalability of the system through the simultaneous use of several cameras guarantees optimal adjustment to the specific application.

Scalable and Flexible

The information provided by the greylevel, slope and modulation channels is analyzed with image processing algorithms. The evaluation is performed with pixel accuracy across all channels and dependencies between the channels are taken into account. If, for example, two abnormalities in the greylevel image do not exhibit any difference, the additional channels permit further differentiation, thus increasing the accuracy of the assessment.

The new product by Carl Zeiss will be available at the beginning of 2010. The system will support "handy" part sizes common in visual inspections. A flexible concept for part handling enables the integration into production lines as well as manual loading. Thanks to the high scalability of the system, the adjustment to production cycle times in the range of seconds is guaranteed. Carl Zeiss thus opens up new automation potential in production and helps increase efficiency and quality.

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Embedded Vision System for Automated Visual Inspection

National Instruments announced the release of a new embedded vision system that gives manufacturing engineers and system integrators the ability to build high-speed real-time machine vision systems for applications such as sorting products, verifying assembly and inspecting packaging. The NI EVS-1464RT Embedded Vision System is a high-performance, multicore controller capable of processing images from multiple IEEE 1394 and GigE Vision cameras. Additionally, the EVS-1464RT features an extended temperature range, a real-time operating system, a solid-state hard drive and a fanless design, making it ideal for use in harsh industrial environments.

National Instruments Germany GmbH
Tel.: +49 89 7413 130 · info.germany@ni.com · www.ni.com/germany

Firefly MV USB 2.0 Camera Mode with 1.3 Megapixel CMOS Sensor

Point Grey announced the addition of a new 1.3 megapixel USB 2.0 model to the company's Firefly MV line of FireWire and USB digital camera products. The new FMVU-13S2C model is designed around the color version of the highly sensitive 1/3-inch Sony IMX035 CMOS image sensor, which features a 1328 x 1048 square pixel array, high signal-to-noise ratio, superior color fidelity, rolling shutter, and no smear. The Firefly MV's easy-to-use USB 2.0 digital interface, small size, and low price further make this new model an ideal choice for microscopy, bioscience, medical and visualization applications. The Firefly MV line now offers a total of 11 different combinations of image sensor, form factor and interface that are designed to address a wide variety of applications in industrial and non-industrial imaging.

Point Grey Research, Inc.
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GigE Cameras with Integrated LED Lighting Control

Baumer's new TXG series of GigE cameras is available with additional I/Os to increase the flexibility and capability of machine vision systems. This special functionality allows the control of custom-designed LED illumination modules directly from the camera's four independent outputs next to the trigger and flash connection. Each output provides a user-defined pulse width modulated (PWM) signal which can be tailored to drive custom-designed LED illumination modules. The internal PWM controller can be programmed to set both the duty cycle as well as the frequency of the modulated signal. Each port is independent and provides a current of 100 mA. Combined with the sequencer, a function which allows to take several images with different settings and illumination, engineers can use the TXG series of cameras to quickly, easily and cost-effectively solve machine vision tasks with a compact configuration, eliminating the need for an external LED illumination controller.

Baumer Optronic GmbH
Tel.: +49 3528 4386 0 · sales.de@baumergroup.com · www.baumer.com

Machine Vision Software: New Version 6.0 Available

NeuroCheck machine vision software is used in mission-critical inspection systems for real-time quality control on the production line. NeuroCheck 6.0 represents the culmination of five years of development for a brand new version of the machine vision software. The new .NET version is a result of dynamic evolution and intensive development, for the user the new software offers significantly improved capabilities for integration into networked manufacturing facilities and for visualising the inspection processes in automatic mode as well as many dramatic improvements. Radical development of the automatic mode of operation has lead to custom and standard visualization tools for comprehensive process view graphical user interfaces. The new software can run under Windows XP and Windows Vista.

NeuroCheck GmbH
Tel.: +49 7146 8956 0 · sales@neurocheck.com · www.neurocheck.com

New CameraLink Camera Series

With the new monochrome DS1-D1312 and MV1-D1312(I) cameras, with CameraLink interface, Photonfocus is introducing nine new CMOS cameras, based on the newly developed 3rd Generation CMOS imagers A1312 and A1312I. All cameras are based on the newly developed A1312 and A1312I image sensor from Photonfocus, which were optimised for applications in the visible as well as the NIR (Near Infra Red up to 1100nm). The new MV1-D1312(I) camera series provides a high dynamic range of up to 120 dB with the well known LinLog technology. The new cameras are equipped with a standard or an extended feature set, depending on the camera model and your vision application needs whilst offering an outstanding image quality. The A1312(I) 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

Line Scan Cameras

e2v announced the launch of a new standard in inspection cameras for machine vision and high performance linear imaging. The AViiVA II series of cameras features a new generation of sensors, with resolution up to 4K pixels with various pitches. Available with CameraLink interface in either four or two taps, AViiVA II delivers a dynamic range of 68 dB up to 160 MHz operation. The first releases will be the EM2 CL series, two-tap CameraLink and the EM4 CL series, four-tap CameraLink, operating at up to 160 MHz in standard format (higher speeds available for custom versions). The EM4 CL utilizes e2v's new single line sensors, with either 4096 pixels, 10 x 10 µm or 2048 pixels, 14 x 14 µm and is capable of line rates up to 70 KHz. More camera types are to follow, with new sensors and Gigabit Ethernet interfacing.

e2v
Tel.: +33 4 76 58 30 00 · enquiries@e2v.com · www.e2v.com

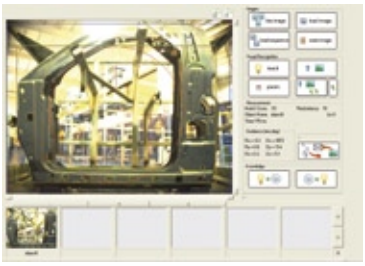
Cost-effective Image Acquisition Board

The latest addition to Dalsa's Xcelera Series of frame grabbers, the Xcelera-CL LX1 Base is an entry-level CameraLink product which is easy to set up and use, delivers highly reliable image acquisition and offers extensive software support. Designed for the PCI Express x1 interface (V. 1.20), the Xcelera-CL LX1 Base can acquire images from a variety of multi-tap area and line scan, color and monochrome cameras. CameraLink operations are supported up to 85 MHz. The Base has also been engineered within Dalsa's exacting Trigger-to-Image Reliability technology framework to more reliably and efficiently control and monitor the entire image acquisition sequence. This cost-effective frame grabber is designed for ease of implementation in a wide range of OEM imaging applications including electronics and semiconductor inspection, as well as general purpose machine vision applications.

Dalsa
Tel: +1 514 333 1301 · info@dalsa.com · www.dalsa.com

Visual Recognition

Comau introduces Recognisense: a single camera, 3D recognition system providing robotic guidance without the use of calibration targets or structured lighting. Utilizing the latest in Power over Gigabit - Ethernet technology and a patent pending interface, Recognisense features extreme ease of operation, high flexibility, low investment, decreased Mean Time To Repair, and increased Mean Time Between Failure. Born from the realization that today's machine vision based robotic guidance is much too complicated and costly, Comau's Recognisense is a single camera, single cable, simply programmed visual recognition system providing six degrees of freedom (X,Y,Z, Rx, Ry, Rz) plus object recognition output in a process time under 150 ms for a 6'x4' field of view.



Comau
Tel.: +1 248 353 8888 · recognisense@comauinc.com · www.comauinc.com

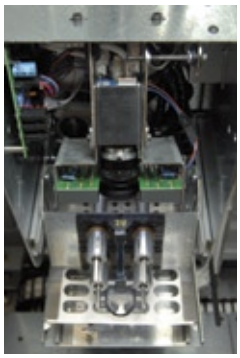
Custom Lenses for Critical Machine Vision Applications

Resolve Optics Ltd. has developed a reputation for designing and supplying superior quality, high resolution custom lenses for a variety of critical machine vision applications. The aim of a machine vision inspection system is typically to check the compliance of a test piece with certain requirements, such as prescribed dimensions, serial numbers, presence of components, etc. All the information a machine vision system collects comes through the front-end optics. The use of optimized custom lenses can reduce image processing as well as improving system performance and measurement robustness. While off-the-shelf lenses may be suitable for some applications - Resolve Optics specializes in lenses designed to fully meet the optical and mechanical constraints of the most demanding machine vision applications. As well as developing custom machine vision lenses that offer very high resolution over a large image format – the company has designed lenses with a large depth of field, a wide field of view for close-up imaging, compactness and lenses that offer exceptional contrast.

Resolve Optics Ltd
Tel: +44 1494 777 100 · sales@resolveoptics.com · www.resolveoptics.com

Ultra-compact GigE Camera

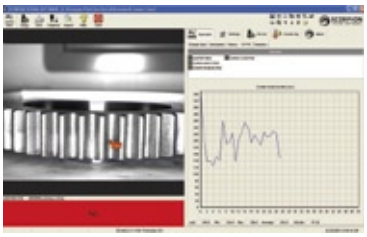
Established in 2006, Manchac Technologies designs and develops advanced pharmacy automation products aimed at long-term care, retail and assisted-living facilities. Automation was only recently introduced to the pharmaceutical industry in order to improve on the accuracy, accountability and productivity of prescription fulfillment, while conforming with industry standards. Manchac's Dosis is a machine that uses computer vision to count pills and package them into bubble-pack containers (blister cards). Dosis is capable of dispensing up to 60 different solid oral medications at a time. The system is driven by an off-the-shelf PC running a Linux operating system. It incorporates the XGA resolution (1024 x 768) Prosilica GC1020C color camera with a GigE Vision compliant interface. Manchac chose the GC1020C for its ultra-compact size (33 x 46 x 38 mm), excellent image quality, and Software Development Kit for Linux.



Prosilica Inc
Tel.: +1 604 875 8855 x123 · sales@prosilica.com · www.prosilica.com

In-line Porosity Inspection for Metal Casting

Valentine Robotics has successfully integrated in-line quality inspection for the detection of porosity in metal castings. Valentine Robotics Vision & Systems Group utilized Scorpion Vision Software to detect porosity, voids and pits in metal castings of down to 0.5 mm. Porosity in metal castings causes premature wear and weakened metal structure in metal castings. The defect detection system enables inspection during production, increasing part quality and production output. This is made possible through the use of Scorpion software and off the shelf hardware. The flexibility of the Scorpion Vision software allows for multiple inspection applications not limited to defect detection. "We've been successful integrating these systems because Scorpion Vision has tools which allow us to classify defects. Without these tools and the advancement in LED lighting technologies, porosity inspection would be more complex and less cost effective," said Andrew Valentine.



Valentine Robotics, Inc.
Tel.: +1 586 979 9900 · sales@valentinerobotics.com · www.valentinerobotics.com

Hardware Bayer Support

Bitflow is pleased to announce that for the first time its Karbon-CL frame grabbers uniquely perform real-time "Bayer" color conversion for Basler's new Sprint color line scan cameras. Anyone that develops color line scan applications with the Basler Sprint color cameras can now capture and process the color data in real time. The Karbon-CL frame grabber performs the Bayer conversion in hardware, eliminating the need for using the CPU to perform conversions post acquisition. The new Basler Sprint is the fastest color line scan camera on the market. The family includes models with resolutions from 2k to 8k pixels, and maximum line rates from 10 kHz to 70 kHz. These extremely high line capture rates and the resulting short integration times require very high sensitivity and a low noise level to achieve excellent image quality.

BitFlow, Inc.
Tel.: +1 781 932 2900 · sales@ bitflow.com · www.bitflow.com

10 MPixel CMOS Image Sensor

Framos introduces the new Aptina 10 Megapixel 1/2.3-inch CMOS Image Sensor. The MT9J001 features Digital Clarity, Aptina's low-noise CMOS imaging technology that achieves near-CCD image quality while maintaining the inherent size, cost, and integration advantages of CMOS. The active-pixel digital sensor has an active pixel array of 3,856 H x 2,764 V including border pixels. It can support 10 megapixel (3,664 H x 2,748 V) digital still images and a digital video mode (3,840 H x 2,160 V) which is equivalent to Full HD 1,080p resolution. It incorporates sophisticated on-chip camera functions such as windowing, mirroring, column and row skip modes, and snapshot mode. It is programmable through a simple two-wire serial interface and has very low power consumption.

Framos GmbH
Tel.: +49 89 710 667 13 · info@framos.de · www.framos.eu

New IP 65/67 Compliant GigE Cameras

IDS Imaging is proud to announce the launch of the GigE uEyeRE, a new line of rugged GigE cameras compliant with the IP65/67 standards. Besides being able to reliably perform in dusty and wet environments, the GigE uEyeRE cameras come with the flexibility of the Gigabit Ethernet interface. This flexibility allows for high-speed image acquisition with cable lengths up to 100 m. The GigE uEye RE cameras are available in a compact housing and carry all features required in outdoor and indoor vision applications. This new line of cameras is available with CCD and CMOS sensors with resolutions ranging from VGA up to 10 megapixel. Like all cameras of the uEye series, the GigE uEye RE ships with an extensive software bundle to allow for an easy integration into any application.

IDS Imaging Development Systems GmbH
Tel.: +49 7134 961 96 0 · info@ids-imaging.de · www.ids-imaging.de

Stand-alone Image Processing Device

Matrix Vision offers a stand-alone image processing system named mvXCellBox, which is based on the PowerXCell processor. The heart of the system consists of a mvXCell-8i accelerator board with nine cores at 2.8 GHz, four GB RAM and two external Gigabit Ethernet interfaces. The accelerator board stands out with excellent 90 GFlops/s processing power (Double Precision) with a low cost of 43 US$ per GFlop/s as well as excellent energy efficiency of 0.78 GFlops/s per Watt. These are much better values compared to x86 systems. For the image processing part, the mvXCellBox offers one PCI Express x16, which can be used for a frame grabber or another interface board. Furthermore, the Gigabit Ethernet interfaces can be used to connect GigE cameras like the mvBlueCougar series.

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

Small Grub Screws and Developer Kits

From now on Tamron is offering small grub screws for many of its models. The new screws can be used instead of the standard knurled screws and do not stick out of the lens body. One of their advantages is the lenses can be used in very tight spatial conditions. In addition, a limited quantity of developer's kits with the M118FMXX lens series is available for a special price. The kit contains the lens models with 8, 16, 25 und 50 mm focal length. The lenses feature Megapixel resolution, low distortion and a very short minimum object distance. They are small, lightweight and suitable for sensors up to 1/1, 8" (so they also work on 1/2" and 1/3").

Tamron Europe GmbH
Tel.: +49 221 970 325 64 · cctv@tamron.de · http://www.tamron.de

High Throughput at the Relay Station

Vision System Gauges Distances between Relays' Contacts

A relay manufacturer implements a machine vision system for higher quality. This system automatically measures the distance between the contacts of the relays, which were gathered manually up to now. With the new system the producer achieves less waste and tripled the productivity.

In the 19th century when people spoke about relays, they meant something totally different: stations, where stagecoaches changed their horses. With the advance of telegraphy the electromechanical devices got their name from these stations. Over long distances data transmission required a relay to amplify the signal every 18 miles. Today the technology is not used any more for communication; however, relays are still applied: in automobile applications, as circuit breaker or time delay circuits.

The efficient functionality of the relays depends on the correctly dimensioned distance between coil and armature and even more between the closed-circuit contacts. To gauge these contact gaps, a relay manufacturer recently installed a machine vision system in his production plant in the Czech Republic. Previously the employees measured the contacts manually. With the new measuring system from the Austrian company weitblick systems the relay quality increased and the waste could be reduced. Rainer Reisinger, one of the CEOs of weitblick systems, sums up the success of the machine vision system: "The automatic system tripled the productivity of our Czech client."

The key technical challenges in this project were, according to Reisinger, the variation in the shapes and the very specular surfaces of the relay contacts. „It was only with the help of modern machine vision components and a special lens and illumination system that the customer's requirements for precision and reliability could be fulfilled," explains Reisinger.

The machine vision system gauges the contact gaps of relays

Close Collaboration

During the development weitblick systems worked closely together with Stemmer Imaging, the German machine vision specialist. Reisinger remembers the beginning of this cooperation: „The relay manufacturer approached Stemmer Imaging with the task and the sales department there referred the enquiry to us." The customer was particularly keen to get a complete solution from one single provider. "That we could guarantee, because we sourced all the components we need from one supplier: Stemmer Imaging", adds the CEO.

Both companies joined forces to select the optimal machine vision components for this application. In thorough feasibility tests at Stemmer Imaging the engineers identified the components to achieve a high quality image of the relay contacts. The resulting set-up is comprised of a LED spotlight with a suitable lighting control system from CCS, a high-end telecentric lens from Sill with coaxial light coupling for the LED spotlight and a

Rainer Reisinger, CEO weitblick systems, demonstrates the automatic measuring system which consists of three measuring stations and a controller with an integrated PC

Successful Cooperation of Two Companies

The young Austrian company weitblick systems GmbH is specialist in the development of systems for quality control during production. The company recently won the „Schrittmacher" (pace maker) prize for innovation which is awarded annually by the regional Chamber of Commerce together with an Austrian magazine.

Stemmer Imaging, Europe's biggest machine vision technology provider and developer of the software platform Common Vision Blox, offers its customers all the image processing components and consulting services needed to build reliable machine vision solutions for almost any industry. Stemmer Imaging customers can profit from a unique range of image processing products from leading manufacturers.

The software with an easy-to-use interface, developed by weitblick systems, analyzes the image data and displays the results

Dalsa Genie GigE Vision camera. Weitblick systems uses the flexibility of the CVB Camera Suite from Stemmer Imaging's Common Vision Blox software platform for image capture and camera management. The image data is evaluated using software incorporating its own user interface and developed entirely in-house by weitblick systems.

Reisinger sums up: „The customized system has now been installed three times for this application and is being used successfully at three separate locations. According to our customer, the systems are very fast and reliable and allow 100 % monitoring of the products as required."

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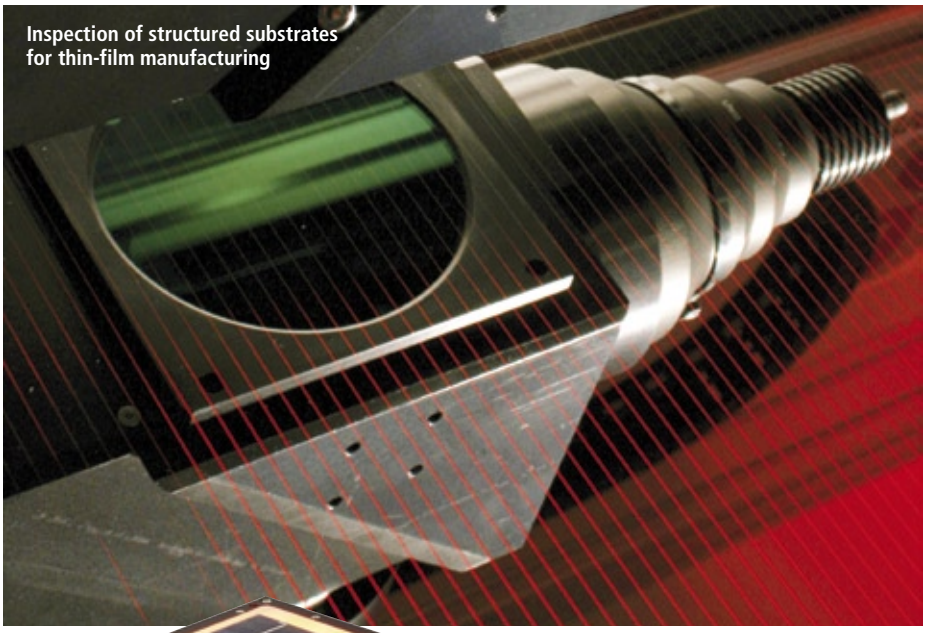
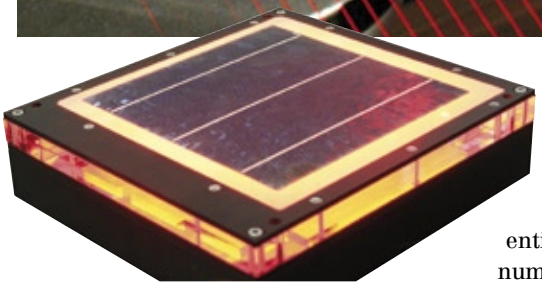
Sustainable Quality Assurance

Line Up of Inspection Systems for Solar Cell Production

The global output of solar cells showed 85 % growth in 2008 and reached a level of 7.9 Gigawatt. This even exceeded the growth record of 2007 at 69 % and a production of 4.3 Gigawatt. Germany contributed 18.5 % to the global production in 2008 compared to 20.5% the year before. In the industrial production of photovoltaic modules, optical inspection systems ensure a consistently high quality of the products and a high throughput.



Inspection of structured substrates for thin-film manufacturing



Optical cell alignment for printing

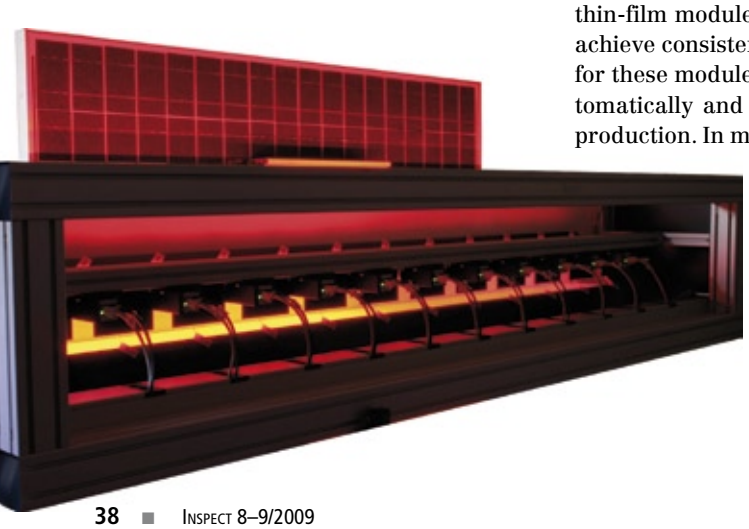
The demand for increasingly powerful, high-quality and affordable products is steadily growing. Solar cells are constantly becoming more finely structured and thus increase the requirement for precision during production more and more. To achieve these objectives the use of optical inspection systems in addition to electrical performance tests is mandatory. On top of assuring the qualitative classification of the individual parts the optical inspection systems provide valuable data about the manufacturing process and thereby open up potential for optimization and cost savings on the manufacturing side. With the G/Solar product range, Graphikon offers a whole set of optical inspection systems for solar cell production, module assembly and glass-based thin film production.

Thin Layers on Large Surfaces

For more than 30 years now solar cells based on amorphous silicon, so-called thin-film modules, are in use. In order to achieve consistent high module efficiency for these modules, they are inspected automatically and process-oriented during production. In many cases optical inspection systems are the technology of choice here. Graphikon offers, under the brand G/Solar Thin Film, a complete series of in-line inspection systems for thin film production. Unlike conventional flat glass inspection systems, which cover the entire conveyor width with a large number of line scan cameras, the G/Solar Thin Film systems need only one camera module.

The camera modules, designed especially for the thin-film photovoltaic inspection, are moved motorically over the surface and thus scan 100% of the substrate within the cycle time of the production line. This economical use of very high quality components results in a significant cost advantages for the customer.

Compared with conventional systems G/Solar Thin Film provides improved detection performance, since the sensor configuration can be adapted flexibly to the optical properties of the substrates. In particular the use of telecentric lenses leads to significantly better images of mirroring reflective surfaces than achievable with conventional lenses. These lenses are used in the manufacture of silicon thin-film modules, CdTe (cadmium tellurite) and CIGS (copper, indium, gallium, sulfur and selenium) after each process step up to the deposition of the absorber layer. In the following step, a



◀ Laminate inspection with stationary mounted cameras

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special dark field system is used, which can also be employed for most back-end applications. The color version of the system evaluates the homogeneity of the surface color.

For most applications, it is necessary to capture images of the substrates with several different optical configurations, such as in reflected light and transmitted light, to enable inspection of all necessary structures. The design of the G/Solar Thin Film system allows for the first time ever, the independent application of various different contrasting methods in one scan run. For this reason it offers images with best dynamics.

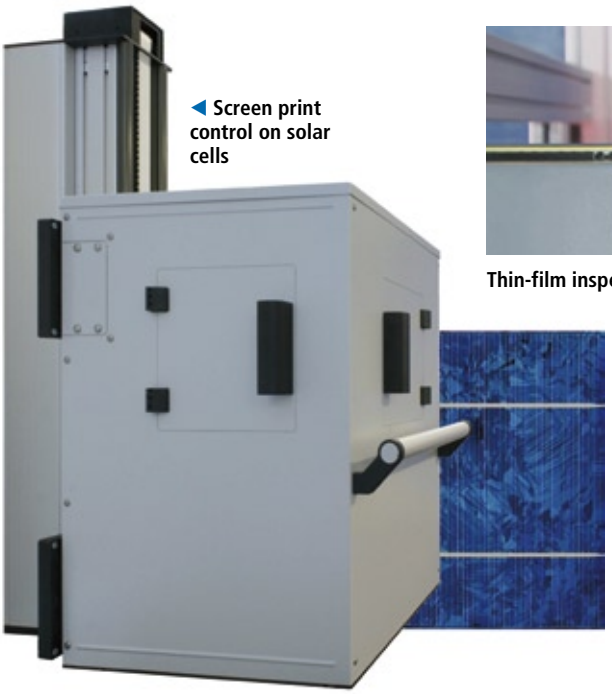
From Wafer to Solar Cell

The series G/Solar Cell was developed especially for the area of cell manufacturing. For virtually every manufacturing step, from the wafer up to the finished cell, quality can be monitored and processes can be controlled in an optimal way. The geometry measurement, the inspection of texturing and of the AR-layer, screen print inspection and the detection of micro cracks are the important tasks. Finally, the same systems are employed in the cell sorters, and will be complemented here with hotspot detection and electroluminescence inspection.

A major focus for quality control is the screen print inspection. With the HighRes system version the middle finger width can be measured down to a precision of ± 0.005 mm. Further quality criteria are interruptions, neckings, alignment to the cell and dimensional accuracy, e.g.

Another important task is the inspection of the anti-reflective coating. During production, the silicon wafers are covered with their typical blue layer. An inspection of this layer can be executed directly after coating or after screen printing of the cells, without the need to pre-define the exact structure of the printing. For quality measure of the anti-reflective layer the operator is interested in the homogeneity of the surface, the color classification for optical appealing modules and the coating thickness. The coating thickness can be measured with an accuracy of up to ± 2 nm, reproducibly on all systems.

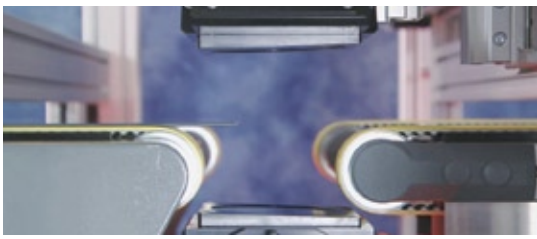
In addition to the purely optical inspection systems, the hotspot and the electroluminescence systems are in use. In both systems, the cells are supplied with current. Local short circuits appear as local heating (hot spots) when the cells, which behave like diodes, are operated in the reverse direction. This method, developed together with the Deutsche Cell, allows the user to assess whether a cell contains critical short circuits in a time span as short as 0.3 s. On the other hand the cell is operated in the conducting direction, which then leads to self-illumination (luminescence). Due to the electroluminescence effect defects are becoming visible that cannot be seen in the classical reflected or transmitted light: very fine interruptions of the screen print, micro-cracks and inactive areas of the cell.



◀ Screen print control on solar cells

Many Cells Securely Packed

The finished cells are packed into modules with, e.g., 72 cells. For the cell sorting, the cell sorter is used. Here, the inspection of the rear and front printing, the color and the hotspot control are employed. In further processing steps, the individual cells will at first be combined to strings (a series of interconnected cells), then several parallel strings are mounted to a module. For the mounting of the strings, the cells will first be aligned optically. After completion of a string it will be visually inspected. This evaluation includes among other things the geometry of the string, the position of individual cells, the presence of solder and the position of the strings for optimal spacing between the strings.



Thin-film inspection on the fly

After all strings have been placed, any remaining defects can be fixed one last time before laminating, using the layup inspection. Finally the subsequent laminate inspection serves the qualitative assessment and the process control.

Commonalities despite Specialization

All Graphikon systems use matrix cameras in conjunction with flashed LED lighting. This combination ensures maximum accuracy of the cameras as well as maximum durability of the lights. Additionally different lighting scenarios are viable in a flexible flow. Thanks to patent-protected contrasting methods, combined with innovative calibration procedures, the systems obtain the highest achievable accuracy. The assessment of the inspected products is done by a freely configurable classifier based on the specific characteristics identified. The inspection systems series is rounded off by customer-specific solutions such as a control framework.

Graphikon has been providing inspection systems for the photovoltaic industry since 2004. Based on 20 years of industrial experience and due to their innovative technology these systems are setting standards in the fields of quality assurance and process control.

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Please Read this Leaflet Carefully …

Vision Sensors Detect Incorrect Sheets in Print Finishing

If a package insert is allocated to the wrong drug, it may have serious consequences. To avoid such situations the printed sheets are proofed with vision sensors already in the bookbindery. The machine vision system inspects whether the actual camera image is identical to a previously taught-in reference image. Thus, incorrect sheets are identified and separated.

An unprinted page in a novel is annoying, and if the reader therefore misses required information, he will put away the book. Also, an upside-down page devaluates the glossy photo book. Such incidents are inconvenient but they are by far not as potentially perilous as a mix-up of package inserts of drugs. In each case the bookbindery folded, collated or bound the wrong sheet. To avoid this, the incorrect sheets should be reliably identified and separated in time to ensure the finishing from exclusively correct sheets.

Inspecting Text and Graphics

Vision sensors detect incorrect sheets based on the actual printed image. For this task the different image types (text, photographs and graphics) have to be detected fast. The German company Pepperl + Fuchs has developed a sheet identification sensor to comply with these requirements. It monitors the correct sheet fold in collating and folding machines and proofs the conformity of the actual camera image with a previously taught-in reference image or reference code. The vision sensor, which has been developed especially for the graphics industry, detects the significant differences. In extreme cases, Dutch text needs to be distinguished from the English language version. Slight variations in printing quality need, however, to be completely tolerated, since they are no longer of concern in this part of the process.

The machine vision system is comprised of a camera, a lighting unit and the evaluating computer. The camera is enclosed within a robust die-cast zinc housing, where an anti-static glass front lens guarantees safe function even in a dusty environment. The housing is available with side and front line of sight of the camera whereas the focusing cannot be manipulated from the outside. The internal lighting is of high intensity and ensures reliable detection even of weak contrast. Together with the progressive scan CCD chip, the system enables short exposure times for safe detection of fast-moving sheets. The high resolution of 752 x 480 pixels in an image field of approximately 50 x 50 mm² with 60 mm standoff ensures sound function, even with print products rich in detail. An Ethernet interface and proven M12 industry connectors transfer the digital input and output signals.

Inspection Occurs in Time

The teach-in operation is executed automatically. For this the machine vision system determines the position of suffi-

VOS410-BIS successful in practice

ciently distinctive image areas, which are suitable for the comparison and then calculates the associated image acquisition parameters. The inspection itself takes place simultaneously during the machine cycle at a sheet speed of up to 6 m/s and up to 12 sheets/s. The sensor is activated by a trigger signal, e.g. from a photoelectric sensor, and sends back a switching signal, if the current sheet corresponds to the taught-in pattern. With the integrated rotary encoder interface, the trigger signal can be delayed according to the simultaneous evaluation of the pulse sequence. The device can be operated both locally, e.g. stand alone, as well as in connection with other vision sensors as part of a network. In this mode the Ethernet interface enables the image transfer and controls the sensors via corresponding telegrams.

In Comparison to Previous Solutions

Previously the sheets were labeled with a barcode or a Data Matrix code. In addition to the added cost of applying these codes, there is also the disadvantage that the barcode is often cut off early in the process for many printed products, and thus is no longer available when needed for inspection. Furthermore, pure barcode readers with their typical line scan design have the disadvantage that codes can only be detected in lateral direction to sheet movement. As an alternative to code readers, there are the first discrete solutions for print image comparison, which, however, results in additional investment for the additional device and in not inconsiderable expenditure for installing both systems.

The Vision Sensor VOS400-BIS by Pepperl + Fuchs combines both inspection methods in one device: barcode reading and image comparison. In general, barcode and Data Matrix Code are nothing more than special images, just with more degrees of freedom. Thus the user has now the possibility to evaluate barcodes in both directions, along the sheet movement and lateral to it. The vision system for print image comparison is already used as a pure Data Matrix reader and has thus proven itself suitable.

Put into Practice

The German company Wohlenberg Buchbindesysteme (Wohlenberg Bookbinding Systems) is using vision sensors from Pepperl + Fuchs in collating machines and adhesive binders for the detection of incorrect sheets. Camera, lighting and processing unit is integrated into a complete compact system, which does not need any external processing unit. With two evaluation methods in one device, barcode and image comparison, integration effort is significantly reduced.

With a maximum sheet speed of 6 m/s and a cycle time below 80 ms, the vision sensor is suitable for high processing speeds and still has free resources for faster processes in the future. Further degrees of freedom are achieved by the integrated rotary encoder interface for simultaneous offset of the trigger point. An error image memory stores the results of the evaluating unit and allows the simulation of false detections. This memory supports the user also in the setup process and in problem analysis.

The sheet identification sensor VOS410-BIS compares both, print images and Data Matrix codes

Two Reliable Partners

The company **Wohlenberg Buchbindesysteme** is a full service provider in the area of adhesive binding stations at book binders and print presses with integrated finishing. Customers are offered not only standard machines, also individual solutions are initiated. Technological innovations, like the Winjector vacuum system or the Navigator graphically interactive system control, minimize set-up times and increase the high machine availability.

Pepperl + Fuchs supplies optical sensors of the Visolux trademark in the areas of printing and finishing for over 30 years. The sensors detect reliably even difficult printing substrates in all operating conditions. The manufacturer has also adapted to the lifecycles of printing machines and ensured decades of availability for its sensors. For every development, high value is placed on compatibility and easy retrofit so that the user can change over to the next sensor generation with no downsides.

Also in normal operation mode, the fast image transfer enables a visual check-up and plausibility check. Crucial for Wohlenberg's purchase decision was the fact that this vision sensor is produced entirely by Pepperl + Fuchs. Therefore, long-term availability has been ensured.

Vision Sensors in Print

Up to now application of machine vision systems in the graphics industry is predominated by customer-specific isolated solutions. The demands of printing presses to any sensor solution with regard to independence from printing substrate or layout, and high standards with regard to reliability, service life and long-term availability place a high entry barrier for vision systems. Furthermore users require sensor solutions as simple as conventional sensors, e.g. a photo sensor, in mounting, connection and use. In recent years, these demands could be increasingly fulfilled by so-called vision sensors. These machine vision systems are factory-tailored to applications and application areas via hardware and software components. Therefore the vision sensors are more compact and more cost-effective than classic vision systems and are starting now the breakthrough for industry-wide use.

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Solution for Pharmaceutical Packaging Inspection

Microscan introduces the new I-PAK SE, the only complete turnkey solution designed specifically for pharmaceutical lot tracking and validation. As a complete and easy to use package, it maximizes efficiency and ease of use while enabling the pharmaceutical industry to meet the requirements of 21 CFR Part 11 for reliable, accurate and validated inspection of labels and products. At the core of the complete solution is the proven I-PAK inspection system already in use by major pharmaceutical manufacturers worldwide. This machine vision system is based on patented Visionscape hardware and software accessed through a customized software GUI designed specifically for pharmaceutical inspection. The new I-PAK SE takes this proven solution one step further to ensure ease of installation and line use by pairing the core inspection system with an industrial touch screen PC, packaged inside a stainless steel enclosure that is wash down rated.

Microscan
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info@microscan.com
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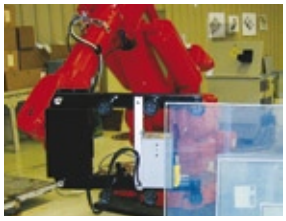
Gauge for Measurement of PET Performs

The CentriScan gauge of Agr International provides vision-based, high-precision thickness and true diameter measurement of transparent cylindrical objects. This device performs 360° sidewall measurements in two increments around the complete circumference of the object in less than 15 seconds. Thickness measurements at 0°, 90°, 180° and 270° are displayed on the operator screen along with a polar plot for thickness and diameter. In one, easy step, the CentriScan gauge provides minimum, maximum and average thickness as well as minimum, maximum and average diameter. In addition, the unit can be setup to report Total Indicated Run Out (TIR) or concentricity or Out of Round (OOR). The visual reference provided by the gauge enables operators to quickly verify proper thickness distribution and concentricity as well as deviations from a predefined limit.

Agr International, Inc.
Tel.: +1 724 482 2163 · marketing@agrintl.com · www.agrintl.com

Precise Handling



Qcomp Technologies presents a new insulated glass (IG) automatic load and unloading system to its glass handling product line. The new IG system uses a six-axis ABB robot and Qcomp's machine vision system to unload IG units from the production line and place them into slotted glass racks. The company also provides a system that can pick single lites from slotted racks and load them onto the IG production line. Utilizing an ABB six axis robot and a proprietary vision technology, the system can precisely locate the rack slots to load and unload glass and can be calibrated for various glass and unit thicknesses. Capable of handling a large range of glass sizes the system also features seamless integration with line controls.

Qcomp Technologies, Inc.
Tel.: +1 920 757 0775 · info@qcomptech.com · www.qcomptech.com

Ingots under Control

Geometry Inspection of Silicon Ingots for Solar Wafer Production

Wafers, thinner than 800 µm, are the basis for the production of solar cells and solar modules. For this, silicon blocks, called ingots, are cut into fine bearings. The ingot's geometry is inspected previously due to the fact that only intact wafers can be processed further. A new automatic measurement system undertakes the task of providing reliable and repeatable results, which are quickly available, more precise than taking measurements manually.

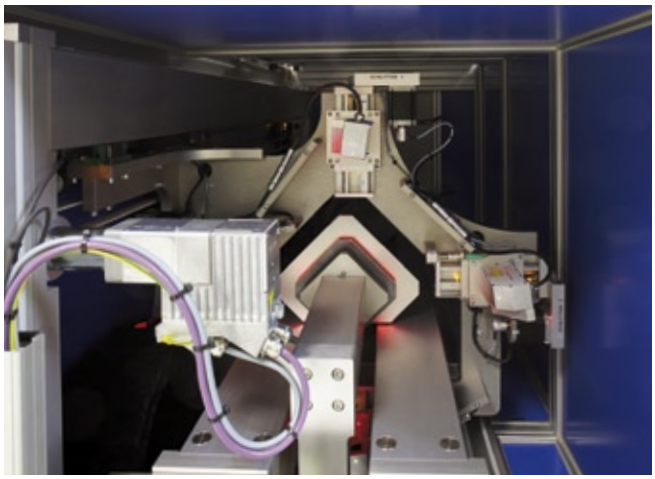
Silicon wafers are used as substrate for the production of solar cells. To produce them, cropped ingots are cut into slices. Those slices are thinner than 800 µm. To assure the geometry of the wafer, the ingots are inspected before sawing. If defective ingots are cut or wafers are processed exceeding the tolerance limit, it adds unnecessary cost due to material usage and loss of time. Up to now, the geometrical control of the ingots occurs manually which needs time. Furthermore, the manual measuring provides only local statements about the quality of the silicon block. That's why the company Micro-Epsilon has developed a fully automatic type of inspection system that uses non-contact sensors.

The Previous Process

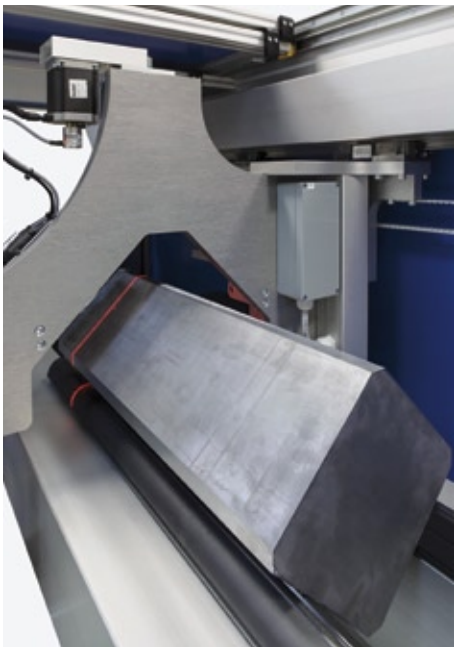
Regardless of which process is used to manufacture an ingot, whether it is monocrystalline or polycrystalline, any ingot can be different from the desired form. If the geometric deviations exceed a specified limit, it must be decided, whether a cropping process brings back the ingot into the tolerance range or not. These deviation points have to be located and marked up. After the cropping individual sections of the ingot remain which are known as "bricks". It is from these bricks that wafers are sawn that later exactly fit into the matrix of the solar module.

At the manual inspection the chamfered, squared ingot (brick) is checked by using a caliper gauge. Typically, due to time constraints, this process is only carried out at three different points on the length of the ingot. The recorded data is transferred to a database on a PC. Surface defects can be visually identified, although flatness deviations of the side surfaces or a "banana shape" of the ingot cannot. However, such defects can cause problems when attaching the support glass, which is required for downstream sawing. If wafers detach themselves from the support material during sawing, this can lead to a costly, lengthy shutdown of the wire sawing machine. The manual measurement takes approximately 20

The fully automatic inspection system measures side lengths, phase lengths, angles and diagonal lengths of the ingots



◀ The sensors traverse along the ingots during measurements



▶ Four laser scanners placed on the sensor base plate measure the master part

minutes. All the areas on the ingot declared as NOK are marked up by hand. After this, the inspected ingot reaches the cropping station, where the defective areas are reworked.

Automatic Inspection

In order to optimize the less reliable, manual geometrical inspection process, Micro-Epsilon offers a fully automatic solution, where the ingot (brick) only has to be inserted into the measuring station and removed again after the geometrical measurements are completed. This measurement system known as "dimensionControl 8260 for Ingots" inspects the surface of the ingots using several laser optical sensors (line scanners). It measures automatically the side lengths, phase lengths, angles and diagonal lengths of the ingots. Also the flatness and the weight of the side surfaces can be verified.

For the automatic measurements the ingot is manually inserted into the machine using lifting equipment. The system then automatically calibrates itself to the respective ingot using integrated master parts. It can be calibrated to the most common sizes of ingots, including 125 mm x 125 mm, 156 mm x 156 mm and 210 mm x 210 mm. The nominal values are transmitted to the measuring system from the host PC or computer. Alternatively, a barcode scanner can be used or the operator can manually input the data.

Measuring Points Every 1 mm

Four laser optical line scanners are placed on a sensor base plate. Each scanner projects a laser line onto the ingot. The reflected line is detected and evaluated by the scanner. It contains precise information about the geometry of the ingot. During the inspection process the base plate with the sensor system traverses along the ingot. In doing so, measurements can be performed at specified distances, typically every 1 mm. The profile information is lined up during the measurement so that the surface of the ingot can be virtually reconstructed. Defective points on the ingot are marked up automatically, using an integrated marking unit, or manually. Defect limits can be specified via software. For example, the user specifies that new bricks should not be marked up until there are 10 similar, sequential defects. Afterwards the automatic measuring system compares target data with the measured values and then classifies the ingot accordingly.

Reflective and Matt Surfaces

Depending on the machining state of the ingot, the surface alternates between reflective and matt. In the normal case, the exposure time at the sensor regulates itself automatically for each profile depending on the reflection characteristics of the surface. However, if the surface changes within one laser line, most conventional scanners cannot cope. For this case Micro-Epsilon has developed a dynamic exposure changeover for these changing surfaces. Using this function, poorly reflecting and reflective areas of the ingot are optimized and illuminated accordingly.

The system is currently being used by customers for ingot lengths of up to 800 mm. This can be expanded up to 2,500 mm if required. The weight of the ingot plays an important part in determining the yield. Therefore, the system is also available with an integrated load cell or weight cell.

Conclusion

Automated optical inspection brings numerous benefits compared to manual measurements. The results are repeatable and accurate. The ingot is measured from all sides, so measuring data is more significant than with the local manual method. The measuring process itself is a non-contact process and so does not exert any mechanical influences on the target. Micro-Epsilon developed the inspecting system's sensors and software, as well as the mechanical and the electrical design. Therefore, the company is able to modify all components in order to match them with each other optimally. This automated geometrical inspection system saves time during ingot inspection and ensures that only intact bricks are processed further.

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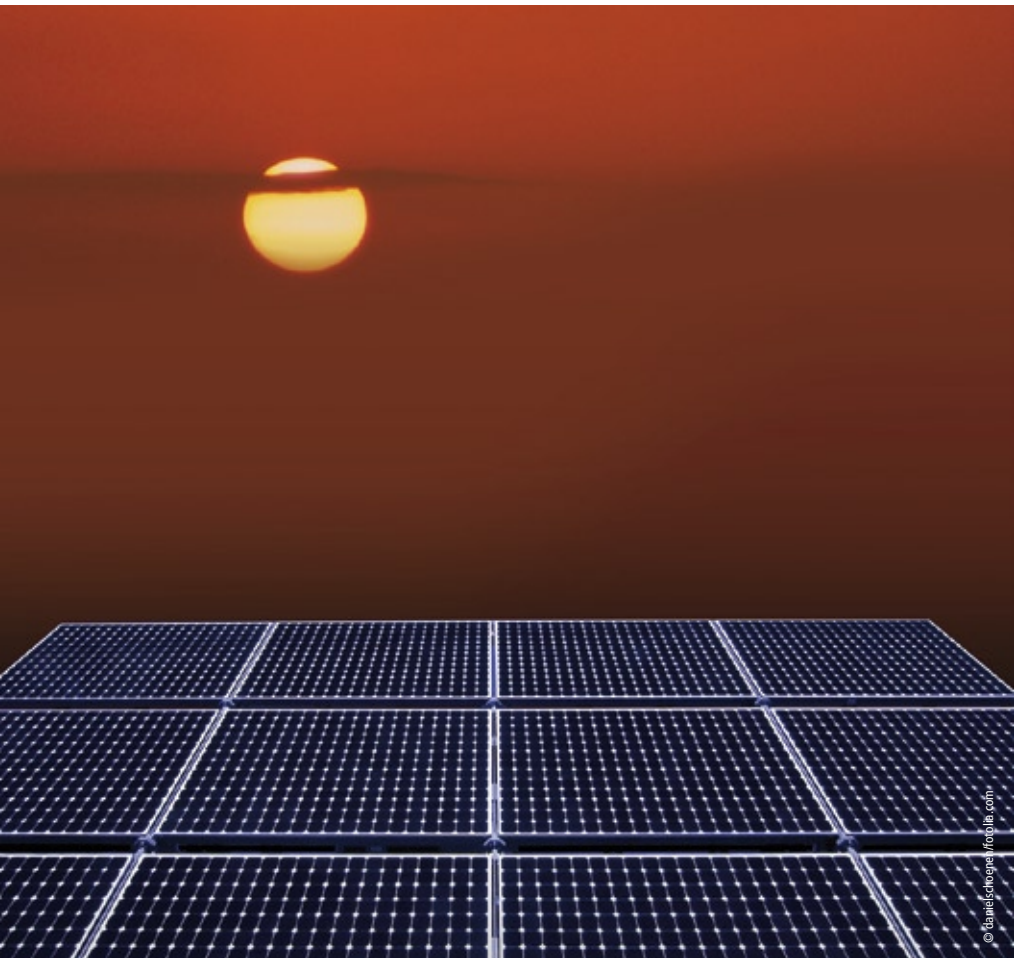
Gentle Glow

Photovoltaic Cell and Module Inspection Using Electroluminescence Imaging

The photovoltaic industry expects to regain its stable growth in and beyond the year of 2010. This growth is likely to be accompanied by demands for a significant increase in the quality of PV products as well as a simultaneous reduction of manufacturing costs. To achieve these goals it is imperative to improve production yields of solar cells and panels. The automated visual inspection of PV cells by electroluminescent imaging and quality control could become a vital factor.



Sensor Type	Camera	QE at 900 nm/ 1000 nm	Read-Noise	Dynamic range	Resolution (Mega pixel)	Measurement time (exposure/ total cycle)	Use within PV production
Interline	Clara	10 %/2 %	4 – 10 e-	67 dB	1.4	3s/3.1s	offline inspection
EM-CCD	Luca R	27 %/8 %	< 1 e-	73 dB	1	0.9s/1s	stringer, laminator, flasher
Deep-depletion	iKon-M BR-DD	90 %/45 %	10 e-	80 dB	1	0.2s/0.6s	cell sorter, stringer
sCMOS	under development	15 %/4 %	2 e-	84 dB	5.5	tbd	laminator, flasher

Comparison of different Si-CD sensor types based on Andor Technology cameras

Electroluminescent (EL) measurements are essentially the inverse of the photovoltaic (PV) effect whereby a solar cell or panel does not absorb light but rather emits it upon application of electric current. A conductive cell subjected to 3–10 A constant current will experience a number of radiative recombinations between electrons and holes leading to weak emission of light. Defective areas, however, will remain dark.

Advantage: EL Measurement

Quality inspection based on electroluminescent measurements offer several considerable advantages:

- Analysis and detection of a large and varied number of structural defects during cells and modules production cycle,
- spatial-resolved detection of defects and feedback loops for corrective measures in the production processes,
- high reproducibility of measurement results,
- fast detection and analysis at timescales of 1 s and below
- modularity of the approach which can be applied at many stages of the production process allowing for flexible reshuffling of resources depending on current requirements,
- fast returns on the investment.

All these advantages have strong potential of reducing various downtimes caused by methods of analysis slower and less flexible than EL. However, despite electroluminescent inspection being discussed within PV industries already for a number of years so far only a few PV equipment providers offer products for in-line inspection. To date, many suppliers are utilizing the current economic downturn to improve their positioning in this segment.

A variety of typical production defects can be detected by the use of EL inspection: Electrode and contact faults typically stem from blemishes in screen-printing masks, cracks in the silicon wafer or are due to problems during electrode soldering. Such spots as well as shunts can be visualized as low-light areas on the cell.

Micro-cracks within a cell are of particular interest since they are often missed by superficial inspection. These defects may lead to more widespread damage especially when a cell is subjected to mechanical or thermal stress. Consequences of this can be damning, resulting in substantial material losses and prolonged process downtimes.

Straightforward Set-up, High Camera Requirements

The measurement of the EL phenomenon is straightforward and requires only a power supply, the PV cell itself and a dark box with a digital camera connected to a PC for the analyses of the camera images. The choice of the camera, however, is essential for the automated analysis of EL.

The typical spectral response of the EL measurement on a PV production line is in the near infrared (NIR) part of the electromagnetic spectrum and can range from approx. 900 nm up to 1,450 nm. This spectral range is not only outside the visible spectrum but also poses severe sensitivity challenges for most Si-based CCD cameras.

The use of InGaAs sensors for EL imaging with their higher sensitivity in the NIR has been a recurring topic in the PV industry. InGaAs cameras can indeed deliver millisecond integration times, however, the cost of these systems, the high system noise, low spatial resolution and strict export license regulations make them less than ideal for deployment in the PV industry.

An alternative solution to these limitations are highly sensitive, deep-cooled and low-noise Si-CCD cameras which come with various sensor formats and offer much needed flexibility for EL-based inspection. For EL inspection, four parameters are of special significance: quantum efficiency (QE), read-noise, dynamic range and spatial resolution (see table).

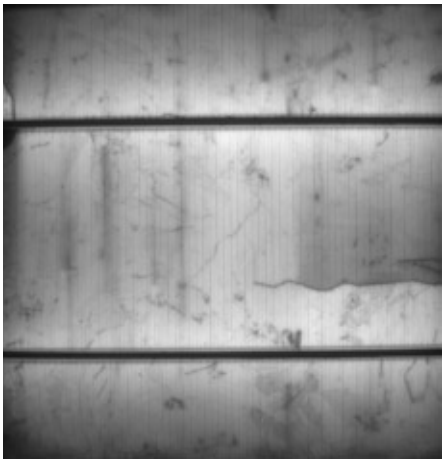
Cameras based on interline sensors (e.g. on ICX285 from Sony) have been often used for EL measurements thanks to their enhanced NIR mode. However, 3 s required to obtain images for automated quality control analysis are not fast enough for cell and module inspection.

Promising New Avenues

EMCCD (Electron Multiplying CCD, www.emccd.com) sensors offer virtually negligible readout noise thanks to integrated signal enhancement electronics. This feature makes it possible to achieve outstanding signal-to-noise ratio as well as higher dynamic range of measurement. An EMCCD sensor used in the Andor Luca R camera has better NIR response characteristics than most interline sensors used in cameras for EL measurements which makes EMCCD a viable choice for PV production line inspection.

Deep depletion CCDs are particularly well suited for measurements in the NIR range and their high quantum efficiency sets them clearly apart from all other Si-CCD cameras. With cameras like the Andor iKon M BR-DD, EL images are characterized by very low noise which can facilitate substantially PV inspection processes. Exposure times needed to produce an image are in the range of 0.2 s making these cameras especially well positioned for high throughput systems like cell sorters and stringers.

Finger electrode defects in the PV cells are clearly seen as darker regions indicating lower or lack of light emission. Image has been taken with Andor Luca R camera and composed from four accumulations each acquired for 8 s (image courtesy of Dr. Karsten Bothe, IFSH, Hameln, Germany)



Micro-cracks in silicon will manifest themselves as distinct lines. Image taken with Andor iKon-M BR-DD CCD camera at an integration time of 300 ms

The advent of sCMOS sensors (www.scmos.com) opens up many new and promising avenues with cameras combining advantages of both classic CMOS and CCD sensors. Cameras with these chip types will become available from 2010 and thanks to their very high resolution will be of special interest for module inspection in the PV industry.

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Benef'cent Is the Might of Flame, When o'er It Man Doth Watch, Doth Tame

(Schiller, Song of the Bell)

ACTech Reduces Costs and Time by 3D Co-ordinate Measuring Technology

For years the demands placed on the dimensional accuracy and material parameters of cast parts have been continuously rising – be it in the aviation and aerospace industries or in the automotive and plant technology areas. Nevertheless, measuring and testing technology is still often regarded as a potential constraint on production or as an additional cost factor. At ACTech GmbH – a worldwide leader in the design and production of casting prototypes and small batches, located in Freiberg/Saxony/Germany, – the opposite is true: Here, measuring technology is a vital resource for saving time and reducing costs and, at the same time, for significantly improving the quality of the ever-increasing complexity of cast parts.

Testing is carried out during the actual production process so that modifications can be instantly implemented to ensure that the extremely short delivery times invariably associated with prototype production will be met. Consequently, new and much higher quality standards are being set compared to those of other manufacturers.

ACTech's core competence lies in the exceptionally fast production of small quantities of very complex, series-comparable cast prototype parts – from industrial pumps, turbochargers and V-10 motor racing engines right up to components for airplane turbines or rockets. Each month, more than 1,000 new cast prototype parts are produced in Freiberg as a result of the combination of highly specialized rapid prototyping technologies – be it a series-related single part or a small series. ACTech adheres to its clients' stringent demands for complex dimensional testing of the cast parts. Furthermore, ACTech is certified according to ISO/TS 16949.

To ensure that the very highest quality standards of the cast prototype parts are achieved, the AMPG 3600 3D measuring arm from ZettMess was introduced as a co-ordinate measuring system as early as 2001. Three years later ACTech set up its own department for 3D co-ordinate measuring to improve the processes even further. Among other items, the company invested in a CNC-controlled 3D co-ordinate measuring machine and in an optical measuring system from GOM. This established all the preconditions for the dimensional measurement of cores, moulds, fixtures and cast parts – be it as a crude part or a finished part that is ready for installation. The 3D Co-ordinate Measuring Technology Department now employs ten specialists – a number still increasing.

Highly Efficient Link Between 3D Measurement and Production

For the dimensional measurement of crude cast parts for in-house control or for client test reports, ACTech is using the optical measuring system made by GOM which is also being used to check mould elements or devices for heat treatment. Up to 25 parts are measured each day. GOM's system is based on the triangulation principle where two cameras record a stripe pattern projected onto the measured object. By way of image analysis and evaluation, the system calculates super-precise 3D co-ordinates for each camera pixel and produces a polygon network of the object's surface. This polygon network is evaluated by the corresponding software in a direct comparison with the nominal CAD data.

Bronze bust of Schiller at the library of Weimar

The system configuration used ensures an accuracy of up to 0.05 mm. For further requirements, the Tritop photogrammetry system, also a GOM product, is available for particularly large parts. Triptop enables highly accurate measurement of all produced parts up to approx. 2,500 mm in size.

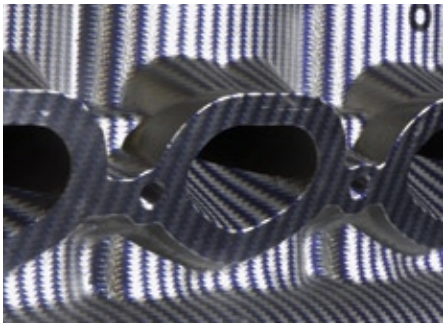
A very noteworthy point in this context is the highly efficient link between the production process and the measuring technology that has been successfully introduced at Freiberg: The company's CNC machining uses the measuring data records to establish the optimal fixture situation for the given part on the CNC machine. This results in major time benefits, while the accuracy with which the machining alignments are fixed achieves a significant improvement of efficiency and process reliability.

Important Data for Reverse Engineering

The optical 3D measuring system is also being successfully employed at ACTech as a supplier of data for reverse engineering. Old and no longer functional components, for instance from vintage engines, are scanned. The polygon network is then transferred as a data record to any CAD system, where the polygon networks form the design basis for replicas that can then be cast by ACTech technologies. The properties of the new cast parts correspond 100 % with the original part. It is not only industry and old-timer fans that benefit from this method, but also the arts. For instance, in 2005 the enormous plaster bust of the great German poet Schiller, created by the sculptor Johann Heinrich von Dannecker, was for the very first time cast in bronze. Until then, the bust from the year 1805 had never been cast in bronze because it was too sensitive to be used to produce a casting mould. Consequently, the original was scanned, contact free, with the mobile optical measuring system at the sculpture's home in the Weimar Museum. Within four hours a data record had been produced that subsequently formed the basis for creating the mould by CAD that would produce a bronze casting of outstanding quality.

During the Schiller Commemoration Year 2005, ACTech donated the bronze bust to the "Foundation for Weimar Classics and Arts Collections" for the reconstruction of the Anna Amalia Library. However, this was not a scaled down replica, as is often the case with conventional replicas on account of the shrinkage factor, but a bronze bust the same size as the original.

Measuring of a cylinder head with an optical measuring system made by GOM



Dimensional measurement of crude cast parts for in-house control or for client test report

Further Expansion of Production Measuring Technology

The optical measuring system at ACTech makes an important contribution to the improvement of dimensional quality and the need for short delivery times. Since the tests are carried out directly during the production process, the specialists can react quickly where it is necessary to make adaptations or corrections. This saves vital capacities as well as production time. It is a matter of course that the process chain is rounded off right up to the final dimensional test and is documented in the form of initial sample test reports or test reports in conformity with the requirements of the clients.

Moreover, the use of the most modern measuring and evaluating software on the basis of CAD data, and the parallel use of online and offline stations, has enormously improved efficiency and the ability to react instantly for closely timed processing during production. In view of its immense importance for the entire production process and the high acceptance level within the company, it is therefore a matter of course that ACTech is continuing to expand the 3D Co-ordinate Measuring Department. Consequently, the existing range of measuring facilities has since been supplemented by a contour and surface roughness gauge from Taylor Hobson and a height measuring instrument from Mahr with the corresponding hard rock measuring plate. It is also planned to invest further in ultramodern co-ordinate measuring technology. The team from the 3D Co-ordinate Measuring Technology Department is also to be increased.

In addition to training and educating personnel in traditional settings, ACTech is ensuring that its specialists are given the opportunity to participate in various expert groups and research teams concerned with the use of computer tomography for dimensional testing in order to contribute to the further improvement of measuring capabilities. It is obvious that Freiberg is far from being weary of innovations.

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Effortless Measurements with Power Lock

Thanks to the PowerLock vision technology, the Leica Absolute Tracker now automatically locks onto any moving target. For the first time in the history of laser trackers, the laser beam moves to the user, not the other way around. Current laser tracker technology requires that the operator pays careful attention that the laser beam between the tracker and the target is not interrupted. Catching the beam requires the operator to find the laser beam, and then physically pass the target through the beam before the tracker can start measuring again. According to some customers this process interruption can account for up to 20 % of their total measurement time. PowerLock prevents from such interruptions. By utilizing a vision system built into the Leica Absolute Tracker the sensor can now determine where a target is without the need for the laser beam to be locked on.

Leica Geosystems AG
Tel.: +41 62 7376767 · contact@hexagonmetrology.com
www.leica-geosystems.com

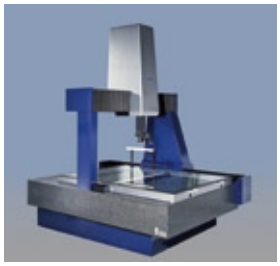
Optical Inline Measurements Three Times Faster

Alicona announces a new release of the high resolution optical 3D measurement device InfiniteFocus. Additional measurement possibilities, higher automation even across large measurement fields and increased measurement speed enhance the inline-capability of the InfiniteFocus sensor enormously. Extended ex- and import of data enhance the efficiency of measurements. Amongst others, the export of Q-DAS supports industrial data management systems and provides faster processing of measurement results. Also, the export of DFX data, and import of CAD data is provided. Measurements with InfiniteFocus have a measurement density of more than 100 million measurement points which ensures a vertical resolution of up to 10 nm. This provides the measurement of even smallest tolerances to keep dimensional accuracy. Depending on the application the sensor can be mounted directly in the production line or on a robot to access difficult positions on a large object.

Alicona Imaging GmbH
Tel.: +49 316 400 07 00 · info@alicona.com · www.alicona.com

Multisensor Technology Now Available for Large Measuring Ranges

With the ScopeCheck MB Werth Messtechnik presents the multisensor coordinate measuring machine for the precise measurement of large volume components in the shop floor environment. The measuring range of this series is up to 1,500 mm in the X-axis, 5,000 mm in the Y-axis and 1,200 mm in the Z-axis. A sensible addition to this machine series is the IP 40T tilting/rotating camera head. Using special changeover kinematics, the ring lighting can be changed out for a fiber probe to perform contact measurements of very small geometries with very low probing force. Together with the Werth Laser Line Sensor LLP, this enables extremely fast scanning of 3D workpieces with high point density. Integrating both sensors in the Werth multi-sensor concept provides maximum flexibility.



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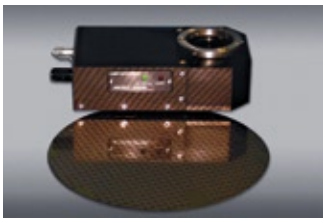
Laser Auto Focus



The Motion X Focus Trac laser auto focus provides real time focus for most all infinite conjugate microscope systems including those manufactured by Olympus, Leica, Nikon, Zeiss, and Mitutoyo and it can be configured to work with many older finite conjugate microscope systems as well as individual telecentric optics. The Focus Trac design is based upon a modified optical version of the "mean transfer function" commonly used in CD/DVD players. By applying advanced optics, mechanics and electronics the system is able to differentiate between "in-focus", "above focus" and "below focus" conditions to produce a relative error signal that can be used to drive the position of the microscope and objectives relative to the sample of interest into an "in focus" condition. While simple in concept the system is unique to each application it has been applied. Such products include Semiconductors Wafers and Devices, Hard Disk Read Write Heads and Disks, Razor Blades, Photovoltaic Substrates, MEMs Devices, Flat Panel Displays and a number of other inspection and vision based applications.

Motion X Corporation
Tel.: +1 805 968 2001 · sales@motionx.org · www.motionx.org

Meaningful Results without Effort

Leica Microsystems has released a new module within the Leica Application Suite (LAS): LAS Image Analysis is a sophisticated software module that automatically performs feature detection, measurement and the evaluation of multiple image features.

Images are acquired using the facilities of LAS in conjunction with a Leica microscope and digital camera. With an easy to use sequence control, LAS Image Analysis guides the user through the whole setup to simplify the process of acquisition, detection and measurement. All settings and configurations can be saved and recalled to exactly recreate the same conditions at a later date. Once the binary image has been produced, a variety of measurements can be made on individual features including size, shape, position, orientation and intensity. The large number of parameters available enables the user to select the most appropriate information for characterization of the specimen.

Leica Microsystems GmbH · Tel.: +49 6441 29 2550
info@leica.microsystems.com · www.leica-microsystems.com

Top Accuracy for Aerospace Application

A leading aerospace manufacturer recently took delivery of one of the widest ever bridge style co-ordinate measuring machine (CMM) ever manufactured in the world. Building on the 40 year heritage of the LK brand, Metris developed the gantry CMM with a measurement volume of 6 m x 6 m x 3 m, to run geometry verification on large aerospace components and assemblies. The gantry style CMM performs with an accuracy of 5 microns, which could only be achieved by the use of ceramic guide ways for the beam and spindle components. Ceramic is an ideal material for metrology because it offers the ultimate in stiffness combined with low weight and excellent thermal properties. Used in combination with double air bearings that prevent torsion, this ceramic LK gantry CMM provides high and long-lasting measurement accuracy. In its final location, the granite rails will be positioned on a purpose built 'U' shaped concrete foundation in order to provide the 3m vertical measurement range.

Metris
Tel.: +32 16 74 01 00 · marketing@metris.com · www.metris.com

Automatic Visual Inspection in Bores

The new inside inspection sensor IPS10 from Hommel-Etamic enables the automatic inspection of bores with a fast 360° all-round view. Inspector-independent surface evaluations with industrial image processing are constantly reproducible and allow the detection of the slightest flaws with many different classifications. Specially designed for automatic inspection inside bores the new inside inspection sensors from Hommel-Etamic Opti-Sens Technology feature extraordinary scanning speeds and compact dimensions. The basis of the new sensor is a 360° all-round optic which transmits the peripheral lines of the bore to the image plane of the inspection sensor by an endoscopic system and projects them there as circle lines. The all-round optic is so compact that bores up to a minimum diameter of 14 mm in inspection lengths up to 156 mm (optional 456 mm) can be inspected.

Hommel-Etamic GmbH
Tel.: +49 7720 602 198 · info.de@hommel-etamic.com · www.hommel-etamic.de

Surface Temperature Detection and Alarm Systems

NEC announced the sale of two infrared thermography products, the TVS-200IS and TVS500-IS, both equipped with body surface temperature detection and alarm features. The TVS-200IS and TVS500-IS measure an object's surface temperature without making contact, and use an object's temperature distribution to produce representative video images (thermal images). Individuals carrying fever, for example, are detected as they first appear at locations equipped with the cameras, which may include airport and harbor quarantine stations, hospitals, public facilities and reception desks. The cameras are capable of measuring a wide range of surface temperatures (–10 – 60 °C), without making direct contact with a subject, and maintaining exceptional measurement accuracy (+/– 1 °C).

NEC Europe
Tel.: +44 20 8752 2794 · sales@eu.nec.com · www.nec.com/eu/

Fluorescence and Confocal Microscopy for a Broader Audience

Olympus has introduced the all-in-one FSX100 fluorescence and FluoView FV10i confocal laser scanning microscope systems to enable even the most inexperienced users to create high-end research images. The all-in-one microscopes are designed to remove all of the complex steps involved in setting-up and using advanced fluorescence and confocal microscopes, ensuring that users can concentrate on the images and data without any prior expertise in the control of the numerous microscope components involved. By coupling high quality microscopy and imaging hardware with precision automation and advanced software, the Olympus FSX100 and FluoView FV10i present simplified workflows so that users can obtain high quality images and image series by: loading their sample; defining their observation mode and regions of interest (ROI); and then capturing their images: as simple as Set-Select-Capture.

Olympus Life Science Europa GmbH · Tel.: +49 40 237 735 426 · microscopy@olympus-europa.com · www.microscopy.olympus.eu

Visionary

Interview with Ignazio Piacentini, CEO ImagingLab

INSPECT: Ignazio, you recently got elected into the Board of the European Machine Vision Association. What was the motivating factor for your decision to invest time and energy here?

I. Piacentini: I attended the first founding conference of EMVA in Barcelona in 2003 (at that time representing National Instruments) and I have followed the growth and progress of EMVA very closely ever since. There were a couple of factors that finally lead to my candidature for the 2009 EC election: EMVA is a European association but is somewhat perceived as having a strong German flavor. This is not surprising if one considers the origin of EMVA and the very strong presence of German companies in the association. I graduated in UK and I have lived in several countries, therefore I think of myself as a very 'European' Italian. I thought this is an asset that would benefit the association. Another reason is the need of the association to attract – and therefore represent – a larger number of small Machine Vision companies, especially system integrators. System integration companies are a vital component of the complex – and still very fragmented – MV market. Today I direct a very small company of eight people, very busy integrating vision and robotics. But I also spent long periods in much larger companies and organizations, with different focuses and goals. The success of EMVA is largely related to the understanding of a broad range of different needs, different expectations, and different interests of its associates. I hope that my personal experience will be useful to the association.

I know that you are a strong believer in alliances and you could envision such an alliance also in the vision sector. What would be the benefits?

I. Piacentini: Excellence is often found within very small, very active, very flexible and very motivated working groups: i.e. small companies. Alas, small high tech companies often suffer from an under-capitalized birth and limited resources. Machine vision is also requiring more and more a very high level of 'specialization': it is unlikely that a small group could tackle proficiently and profitably issues as different as surface inspection and robot guidance, e.g. Alliances, both at national and international level, could lead to the creation of a larger networked 'virtual company' providing benefits in sharing skills and resources, addressing a global market through local work groups, leveraging on a larger 'knowledge' base to provide answers to customers with different needs in different industrial segments, avoiding pitfalls already experienced by others, enabling faster adoption of emerging new technologies, even providing 'larger shoulders' in negotiations with much larger organizations. There are also benefits for the customers: access to a better and larger solution provider, better local support, better access to specific solutions in terms of design approach, development and documentation, quicker response for a variety of needs.

Why then alliances are not formed more often?

My guess is that communication is one of the major obstacles, and specifically keeping up a flow of efficient information exchange between usually overworked groups, followed closely by a mistaken 'paternity' (or maternity) pride of the founders/owners.

Five years ago you decided to leave the position as European Vision Manager at NI to found your own vision company. In retrospect, would you make the same decision again?

I. Piacentini: Leaving my position in National Instruments was not easy. At that time, I took a five-week pause walking and thinking in Nepal along the Tibetan border.

I was originally asked to join NI after the acquisition of some vision software in 1996, developed by Graftek, France. My task was to 'develop the business', and though I consider my period in NI as an overall positive experience, it was also a period of intense frustration. Image processing was something new added to an existing rich company portfolio of products, some of which representing the 'core business' and the very core of success of NI. My take is that it was easy for NI to 'own' the new technology, much less easy to understand and develop a suitable sales/marketing chan-

nel. I have found similar issues in other medium/large companies that offer some imaging as part of a large and diversified product range.

So, to conclude, given the same conditions of 2003 I would do the same today. By the way, I do like NI products, especially software and whatever ImagingLab develops is heavily based on LabView and the Vision library from National Instruments.

What does your company ImagingLab provide that makes it unique among its peers and what would you say is your formula for success?

I. Piacentini: ImagingLab was conceived at the very beginning as a kind of 'design bureau' dedicated to the solution of medium/high complexity vision problems, with a keen interest to integrated vision and robotics. We expected to produce feasibility studies, reports, design and simulation and some specific vision software, but with a very limited involvement with hardware and mechanical design. However, within a few months we were forced to realize that our efforts needed to be extended to full prototyping. Today our main business consists in providing to our customers – most of them 'builders' of complete automated machines or even production lines – fully integrated vision-robotics solutions. A key to our success is due to our 'vision centric' approach to robotics: the vision system is in a way 'master' of a 'slave' robot and we have developed over the years a full vision-robotics software application layer that includes a LabView based robotics library for several brands of robots. Even the software is thus fully integrated, and, from a programming point of view, there is only one software environment for vision and robotics. This leads to a shorter development time and overall better performances of the machines that make use of vision and robotics. We have also promoted and invested in co-design practices with our customers, as well as providing enough technology transfers to allow them to retain full ownership of their machines, while minimizing our need to be involved with commissioning and support to their final users.

Ignazio, thank you very much for this interesting discussion.

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Preview

Look ahead to the following topics of our next issue:

- Trade show preview Vision 2009
- Trends & Technologies
- Image processing basics: Real time
- Cameras, Colour Cameras, Smart Cameras, High Speed Cameras, IR Cameras, 3D Cameras
- Surface inspection at the limit of technical feasibility
- 3D metrology miniaturized and 3D inspection of curved surfaces
- INSPECT Discovery Tour

This and much more can be found end of October in the INSPECT 10/2009.

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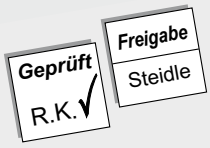

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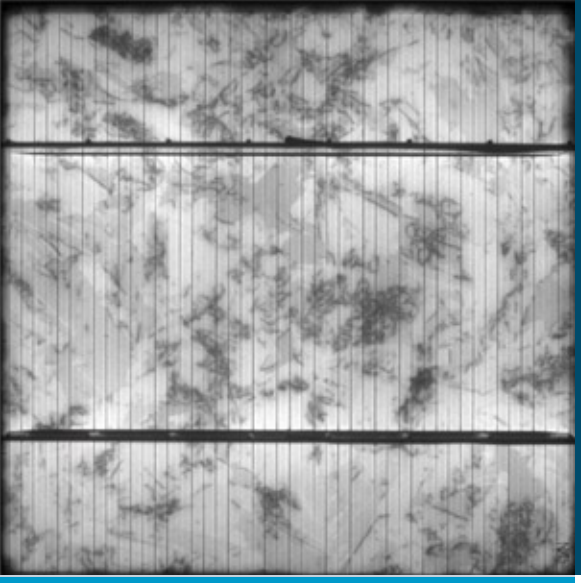

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