10. VOLUME
OCTOBER 2009

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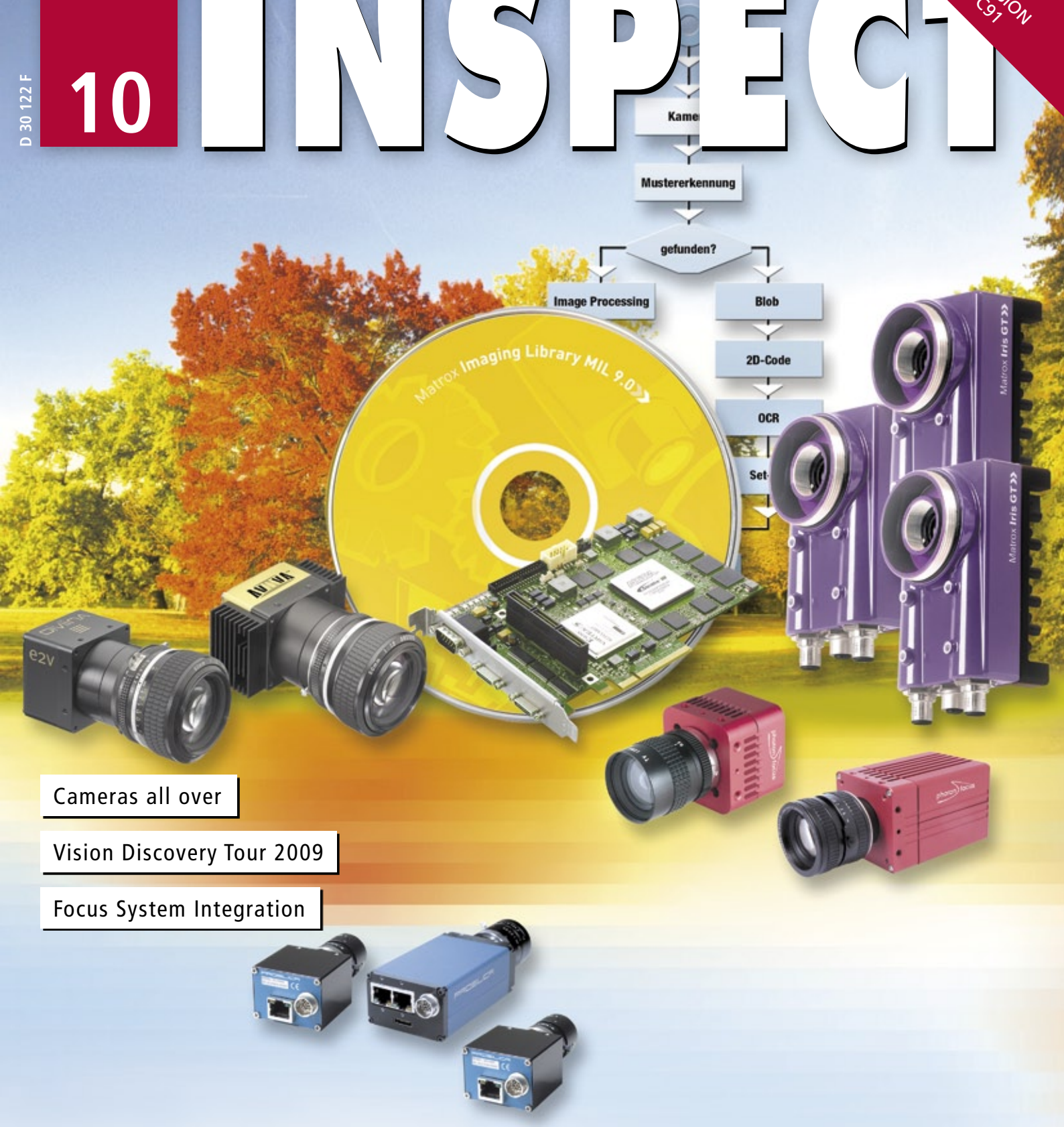
VISION · AUTOMATION · CONT

# INSPECT



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Vision Discovery Tour 2009

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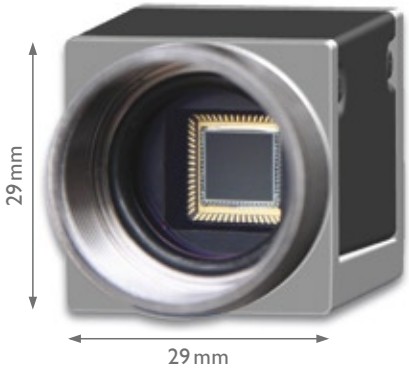


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# Climbing Up

The financial crisis hits the super-rich as well, says Forbes 400, the ranking list of the 400 wealthiest Americans which was updated this autumn. Within one year they lost a combined US$ 300 billion, about € 205 billion. Number 1 on the list is Bill Gates, the Microsoft founder, with an estimated net worth of US$ 50 billion. He had to swallow a loss of about US$ 7 billion. Hit even harder was the investor Warren Buffet who ranks second. According to the American business publication Forbes he lost US$ 10 billion.

But in these difficult times when announcing deficits are on the daily agenda, it is much more interesting to take a look at the winner: Marc Zuckerberg. Within one year the founder of Facebook climbed up from place 321 to place 158 of the Forbes 400. Originally the 25-year-old entrepreneur launched Facebook only for students of Harvard University. After some expansion steps, however, the social network today has more than 300 million members. Zuckerberg explained to Stern, a German news magazine, that it is his goal to gain one billion Facebook users. In Germany, also according to Stern, three-fourths of the 40 million internet users are already members of an online network, and this number is rising. But not only private networks are booming, also in business online networking is growing in popularity such as the business internet portal Xing. But futurologists forecast much more: The personal presence on location will not be necessary any more. Research clusters can join their forces in networks. They can study in the same fields of research without being in the same laboratory. Nike picked up this trend: At the Nike+ 10 km Human Race the runners don't have to be present at any of the 30 race venues. Entrants only need a sensor and the corresponding software and with this, they can do their races by themselves at home. Afterwards they synchronize their data via the network. The Nike+ Community has grown to 1.2 million members from 142 countries at the Human Race in 2008.

But the topic of networks does also play an important role for the industry, e.g., to profit from results of the latest research or to educate employees. To push such networks between industry and academia, first and foremost platform- independent solutions and standardized interfaces are essential.

The importance of standards is something the machine vision industry recognized early on, and consequently introduced the GigE Vision Standard. You can see the benefits coming with this standard in the articles of Baumer (page 42), SVS Vistek (page 60) and Prosilica (page 52). At the Vision trade show, taking place from November 3rd to November 5th, the special exhibition of International Machine Vision Standards will give you an overview about the most important standards used by the industry. The Vision offers much more: starting on page 22 you'll find information about trends and highlights of this year's trade fair.

When you have finished reading this issue, find further information on our internet portal www.inspect-online.com or become a member of our INSPECT network at http://network.inspect-online.com/ to share existing knowledge over thousands of kilometers. Our goal is one billion users as well – help us in attaining this!

**Stephanie Nickl**
**Editor INSPECT**
**stephanie.nickl@wiley.com**

## TOPICS











## COVERSTORY





## VISION

## AUTOMATION



## CONTROL

# Treasure Hunt in Stuttgart

## INSPECT Discovery Tour at Vision 2009


**Cherished by hikers and mountain climbers alike is the hiking pass, given out by the local tourist offices in alpine vacation areas. Every summit conquered is documented here with a stamp and after a certain amount of stamps accumulated in the hiking pass a specific badge will be awarded to the athlete as a trophy. For the Vision trade show in Stuttgart you can also get a hiking pass of sorts, and with a sufficient number of stamps a trophy will be awarded to you as well.**

You'll get your own special Vision 2009 Discovery Tour Pass either as a supplement to the printed edition of INSPECT or from a member of our team in the main hall of Messe Stuttgart during the days of the show, November 3rd to 5th. Every exhibitor of Vision 2009 that is represented with an advertisement in this INSPECT issue, is listed in the Discovery Tour Pass with name, hall and booth number. These are the Vision trade show exhibitors making an effort to get in contact with you, the INSPECT reader, and to inform you about new technologies, products and system solutions.

Get an INSPECT stamp in your Discovery Tour Pass while visiting the booth of these exhibitors, and you will have gained twice: You will have received an excellent consultation for your requirements and your task in machine vision and you will have already won a neat trophy with five stamps only. At the same time you are eligible for the daily raffle of our attractive first prize. This is – what else could have been expected? – a camera of course, for the documentation of your next alpine discovery tours.

Watch out for our hostesses in the main entry hall of Messe Stuttgart, they will provide you with your own personal Discovery Tour Pass and an entry code that gives you free access to the trade show.

After having accomplished your discoveries you'll get your trophy at the INSPECT booth C 91, hall 4, in the midst of the Vision Integration Area, sponsored by INSPECT. Make sure to take part in our raffle for the daily first prize at the same time.

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# Get more vision


BOA: All-in-One Vision System for Industrial Machine Vision

- 44 mm cube form factor, 360° mount support, easily integrated for tight-fit apps
- Monochrome or color sensor - 640 X 480 CCD
- Rugged, IP67-rated housing for harsh and wash-down environments
- Multiple processing engines combines DSP, FPGA and CPU technologies
- Versatile communications via Ethernet and/or RS-232 connectivity
- Embedded point-and-click software – easy to use & nothing to install

## Introducing BOA:
## Next Generation Smart Camera for Single Point Inspection

BOA is a powerful, inexpensive and ruggedized optical inspection solution for the factory floor. Packaged with DALSA's easy-to-use iNspect software, both first-time and experienced integrators can rapidly prototype and deploy vision solutions into their manufacturing process.



## Capture the power of DALSA

Download your BOA product brochure here: www.dalsa.com/BOA/ins10

Visit DALSA at VISION 2009, Stuttgart, Germany, November 3-5, Hall 4, Stand D53 to see a live demonstration of the BOA Vision System.

DALSA

## Point Grey Expands North American Sales Team

Point Grey announced that Marty Karnacewicz has joined the company and is responsible for Strategic Business Development for Eastern North America. Based in New Hampshire, USA, Mr. Karnacewicz will be a part of Point Grey's ongoing efforts to develop new business opportunities and strategic relationships, manage key accounts, and assist customers in Eastern United States and Canada. Mr. Karnacewicz joins Point Grey after working for 10 years at one of the world's leading providers of vision systems and software. In his most recent role as Senior Sales Engineer, he was responsible for the largest OEM's in the Eastern USA in the semiconductor, electronics, document handling and postal industries. Mr. Karnacewicz entered the factory automation and machine vision industry as an Application and Sales Engineer after graduating with a BSEE degree from the University of New Hampshire in 1990. "North America continues to be an important market for us, so we are very excited to welcome Marty as part of our team," says Vlad Tucakov, Director of Sales and Marketing at Point Grey Research. "Marty brings a unique set of skills and experience to Point Grey. His 19 years in the machine vision industry will help us continue to provide a very high level of service to our customers, not just with selecting the best products for their applications now, but also with understanding their needs for the future. We are confident that Marty's abilities to develop and maintain strong business relationships and look at vision applications from all angles will help us maintain, or even increase, our current rate of growth in North America."

*www.ptgrey.com*

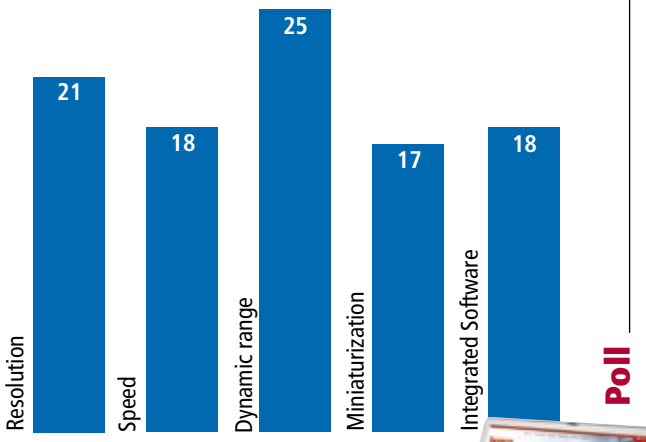
## New CEO at LMI Takes the Helm

LMI Technologies appoints Terry Arden as the company's new CEO. He replaces Len Metcalfe who was a founder and CEO from the start of LMI Technologies. Metcalfe will remain Chairman and largest shareholder staying actively involved in the industry and success of LMI. Terry Arden has been the CTO of LMI Technologies since joining LMI seven years ago. Historically Arden built a machine vision software company before selling it and joining LMI. In his years at LMI as CTO he has successfully built the R&D development team which has created many of the company's successful products. During this time, Terry Arden has also been a key contributor to LMI's management team. "I am excited about what Terry will bring in this next growth stage of LMI" says Len Metcalfe, Chairman of the Board. "Terry's broad experience in sensors combined with his proven leadership skills is key to our success in this challenging economy." Terry Arden's strong background in technology and business development will focus on LMI's continued success as a 3D sensor solution company. His process-driven yet agile style of management will set the foundation for expanded growth of 3D sensor solutions into various new markets. "LMI has exciting growth potential in many markets where 3D shape and/or 2D color are determining factors in product quality. Engineering machine vision problems into simple, fully integrated "sensors that see" solutions is a key LMI capability," says Terry Arden.

*www.LMItechnologies.com*

## Where is the biggest need for further development of current camera technology?

Information in percent




*Source: Inspect-Online*

## Isra Vision: Strategy Succeeds in Mastering the Crisis

Isra Vision AG, one of the world's top five suppliers of machine vision and the global market leader in surface-inspection systems, has once again proved to be robust, despite the global economic crisis. Once more, the multi-segment strategy has shown to be effective. Isra is diversifying across various vision technologies as well as various industry segments and regions. This ensures that the company can supply a wide range of customers in all parts of the world, ones who are generally global players in their respective sectors. In the first nine months of financial year 2008/2009 (October 1 to September 30), Isra was able to keep profitability stable with an EBITDA margin of 24 % and an EBT margin of 13 %. During the first nine months, Isra was able to hold revenues steady at €41.4 million (PY: € 46.7 million). The best performance was achieved in Asia, while business declined slightly in Western Europe and quite markedly in the US. Management expects a stronger fourth quarter, just as in previous years; so that revenues for financial year 2008/2009 are expected to amount to just under € 60 million. Following the successful integration of the group's various acquisitions in recent years, efforts to improve profitability are focused on the optimization of production. Provided the economy does not weaken substantially, the goal will remain the same: to hold the Isra Group's profitability steady at the level of recent quarters, whereby a 15 % EBT margin will be further in focus for medium-term. Further measures to increase efficiency are being implemented on an ongoing basis. Isra keeps the long-term growth in focus. A key component of Isra's growth strategy is external expansion through the acquisition of appropriate targets. A number of projects are already underway in this context, some of which appear particularly promising. In the wake of the current crisis, key investment projects have been postponed in practically all industries. However, past experience suggests that these will be revived in subsequent years. With a further sales and innovation offensive in financial year 2009/2010, Isra is laying the foundation for a return to long-term growth. Management will give a more detailed forecast in December 2009, with its first overview of financial year 2008/2009.

*www.isravision.com*

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VISION 2009 Visit us in Stuttgart, Germany
Hall 4, Booth 4A31

## USB or FireWire, just $199†. Don't let this one get away.

The Firefly® MV digital camera gives you the freedom of choice for a price that's almost free. Select from more than **ten different models**, based on sensor (**VGA** at **60 FPS** or **1.3 MP** at **23 FPS**), interface (**FireWire** or **USB 2.0**), and form factor (board-level or ultra-compact **44x34x24mm** case).

Join the pack at www.ptgrey.com/almostfree

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*Innovation in Imaging*

† When purchasing five or more cameras, 0.3 MP models only

## Kreon Technologies Settles in Germany

Kreon Technologies announced the creation of its subsidiary in Langen, Germany. "This initiative is the answer to the needs of German customers to have a local intermediary" explains Thierry Rebillard, CEO of Kreon Technologies. This local presence of Kreon in charge of Mr. Dag Iversen aims at representing the company's image and main values on the German market. The subsidiary will provide German customers with the overall Kreon range of products, in addition to an optimal client service. "We are very concerned with providing our clients with the best 3D scanning solutions in the best conditions," says Thierry Rebillard. Today, Kreon presents a wide range of scanning solutions for quality control, reverse engineering or surface inspection so as to meet a maximum of needs in demanding industries such as automotive, aerospace, consumer products, and medical. Kreon systems are engineered to put more profit on the customers' bottom line by reducing overall manufacturing costs. Motivated by the will of meeting the largest customer requirements, Kreon's offering includes the versatile scanners of the Zephyr range, the next generation Aquilon laser scanner and the entry-level model, the new Solano in addition to the Kreon Baces measuring arm, a complete and high performance solution at a competitive price.

*www.kreon3d.com*

## New EMVA European Machine Vision Industry Report Released

The European Machine Vision Association (EMVA) has released its annual industry report European Vision Technology Market Statistics 2009. Data from over 180 companies in the European machine vision industry have been evaluated for this report. In comparison to the earlier reports, the 5th market survey conducted by the EMVA includes a new and expanded structure. Readers will find it both more readable – due to more explanations – and more comprehensive. The report provides valid data on the European machine vision industry, its suppliers, but also on applications of machine vision technology and the major customer industries. This is supplemented by developments in all major machine vision product categories. Plus, the study shows current technology and market trends and identifies growth opportunities for the machine vision industry. Besides the general data on the European machine vision industry and the country report on Germany, a new country-specific chapter has been added to cover the machine vision industry in Italy, another major market for machine vision technology in Europe. The new edition also features an introduction to the machine vision technology and a separate chapter on opportunities of machine vision companies both in geographic and socio-cultural areas. Plus, a general assessment of the world economy with a focus on selected customer industries shows the economic framework, in which the European machine vision industry is embedded. On 150 pages with 40 figures and 20 tables, the report provides easy-to-understand and reliable, in-depth information on the machine vision industry in Europe. Enterprises in the machine vision industry as well as stakeholders from industry related areas and business planners and analysts will find a valuable source for strategic decision-making. The data on the European machine vision industry was collected by comprehensive written and face-to-face interviews of companies rather than desk research. Copies of the 2009 European Vision Technology Market Statistics can be purchased directly at the EMVA.

*www.emva.org*

## Cognex Receives Settlement in Patent Dispute

Cognex Corporation has accepted a settlement offer from Multitest Elektronische Systeme GmbH and its U.S. subsidiary in a dispute concerning Multitest's importation and sale of equipment containing MVTec Halcon machine vision software. Terms of the settlement between the parties were not made public. Cognex has alleged in complaints filed with the U.S. International Trade Commission (ITC) and in federal court in Massachusetts that Halcon software infringes at least three Cognex machine vision patents. In addition to Multitest, the ITC is investigating 20 other companies for violating Cognex patents by selling, importing and using MVTec products. The current settlement agreement releases Multitest from the ITC investigation. Multitest is not a party to the federal court lawsuit. "Cognex is pleased with Multitest's decision to resolve this dispute in a rational and business-like way, and we look forward to working with Multitest to integrate Cognex software in its products in the future," said Dr. Robert J. Shillman, Chairman and CEO of Cognex. "Cognex has invested over US$100 million in R&D to develop our leading-edge technology, and on behalf of our shareholders who made that investment, and on behalf of our customers who pay to use our proprietary technology, we will continue to take a very strong stand to protect our patents whenever we discover infringement."

*www.cognex.com*

20 YEARS 09

# GigEvolved


VISION 2009
3 to 5 November 2009
Hall 4, Booth D 33

Break through the 90 MB/s barrier. The Prosilica series of GigE cameras offers a sustained data rate of over 120 MB/s and up to 240 MB/s thanks to an innovative, GigE Vision compliant interface. And if you are using multiple cameras on the same bus, you can even control how much bandwidth each camera utilizes. Now that all Prosilica GigE cameras have joined the camera range of Allied Vision Technologies, you have a virtually unlimited selection of sensors and features with a GigE or FireWire interface. See them all at **www.alliedvisiontec.com**




SEEING IS BELIEVING

# Software Development

## Breaking New Ground

### Configuration Replaces Programming

**Cost for hardware components in machine vision is ever decreasing, but the expenses for software development remain at a very high level. Consequently there is a demand for new concepts in software development: reducing time and effort by abandoning programming in high-level languages like C++ and using more convenient, configuration-type development tools for configuring vision applications instead. Matrox Design Assistant is an answer for this request: It relieves programmers of a significant workload and enables even non-programmers to realize machine vision applications.**

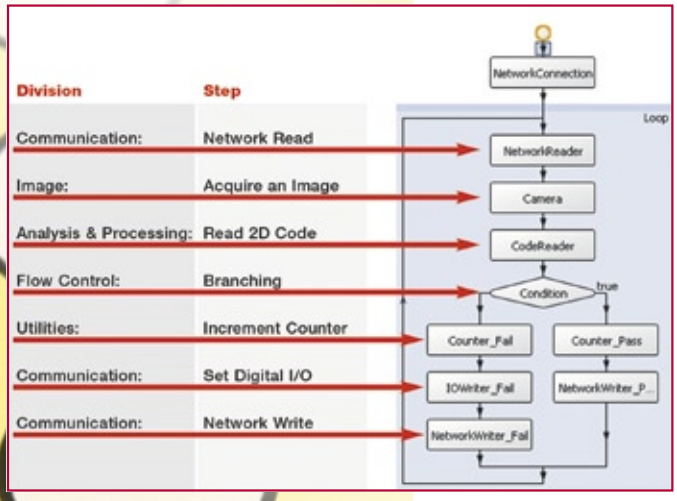



**Fig. 1: The flowchart is build from single steps**

Up to now, software solutions for graphical or visual application software development are facing three main challenges: to keep the workflow clear and simple even for complex tasks, to allow the generation of a customized user interface and to have the option for a fast and easy extension of the existing functionality. The Matrox Design Assistant overcomes these limitations and opens up new ways of software development. This development tool allows easy and quick configuration and deployment of machine vision applications including a user interface for the end customer. This is done with two main tools: the sequence control is implemented by a graphical flowchart and the user-interface is designed with an integrated HTML editor.

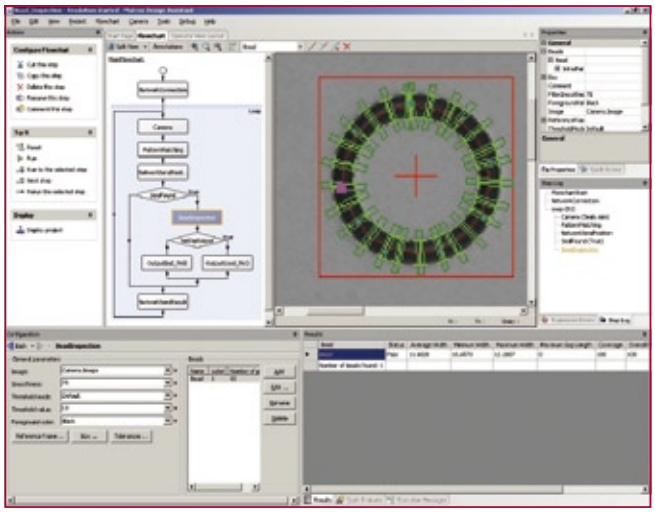
### Flowchart Steps

The flowchart is used to describe the logical workflow of a vision application. It is build by adding and interconnecting single steps, which will be executed sequentially during runtime. The Design Assistant offers a large selection of configurable steps, which are classified into five function groups: Image, Analysis & Processing, Flow Control, Communication and Utilities.

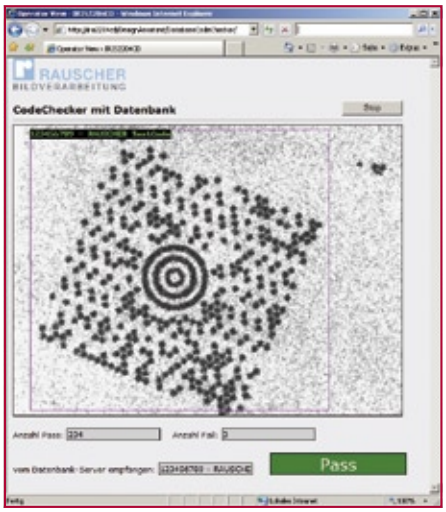
The "Image" group offers image acquisition and restoring images from disk. "Analysis & Processing" comprehends modules for a range of different vision tasks (see box). All algorithms originate from the field-proven Matrox Imaging Library (MIL) and guarantee performance, robustness and accuracy. "Flow Control" provides the steps that are necessary to control the execution of the flowchart. Decision making and branching, entering and leaving sub-flowcharts as well as pause, resume and halt the execution of the main flowchart. "Communication" summarizes functions for communicating with external hardware in the field and to evaluate external events in the flowchart: digital User-I/O, serial RS-232, Ethernet, mouse- and keyboard inputs and industry protocols like Ethernet/IP and Modbus. The "Utilities" group finally holds counters and variables for storing data of any kind. These steps can also be used to generate log files and to create and evaluate timestamps.

### Well-arranged Design

The flowchart is set up with the described steps and is executed sequentially in the main loop (fig. 1). Already during building the flowchart every single step can be configured and tested interactively. The configuration is done via simple configuration masks and a short online help will show an explanation of the most important parameters. The configuration mask does not overlap the flowchart or the im-



◀ Fig. 2: Clear layout: flowchart, camera and configuration panes are visible on a single monitor




▶ Fig. 3: The Operator-View during runtime can be viewed via the Internet Explorer

age of the camera. So the whole design process stays clear and well structured even when dealing with larger and more complex flowcharts (fig. 2).

The Design Assistant offers 38 steps for a fast and convenient solution for all kinds of different vision applications – from simple feature presence/absence checks up to very complex measurement tasks. The algorithms from the Matrox Imaging Library, combined with the flexible communication within the flowchart, with the operator view and external hardware builds a strong platform for all applications.

## Extensions Unlimited

If a requirement comes up, which can not be solved with the existing tool-set of the Design Assistant, a Custom Step SDK can be used for building own steps and for integrating them seamlessly. These custom steps can be used – exactly like the ones that come with the Design Assistant – without programming knowledge. The own steps are programmed with Microsoft C#; developers can optionally use the full functionality of the Matrox Imaging Library. Examples for customer's steps are a FTP client for posting defect images on a special FTP site, a parser for configuration files and special calculation modules.

## Operator View Strictly Separated

Another great strength of the Design Assistant lies in the strict separation between the logical description of the vision application, the flowchart, and the user-interface presented to the end customer during runtime, the operator view. While the flowchart represents the internal logic, the operator view is the graphical user interface for the end customer for visualization and parameterization of the application (fig. 3). The operator view is generated within the Design Assistant with a graphical HTML editor, where all necessary elements are added and interconnected with the flowchart's in- and outputs. Input- and output- fields, buttons, displays for the camera images and other graphical elements can be added. An operator view can be a website which can be seen during runtime from any remote PC over the network. Alternatively the operator view can be programmed for special requirements for example in Visual Basic .NET.

## Powerful Application Development

The Design Assistant is a powerful tool for the quick application development. It allows tackling and solving different vision applications without programming knowledge. In addition a vast amount of flexibility and possibility is offered to expand its functionality – even specialized, custom algorithms can be integrated.

The combination of such an innovative software tool with the highly integrated smart camera Matrox Iris GT, which features an Intel Atom 1.6GHz CPU in an IP67 rated casing is a great offer for OEMs, system integrators and end users. Vision applications can be developed quickly and without traditional and time-consuming code writing.

**Imaging Steps in Analysis & Processing**

| | |
|---|---|
| **Image Processing** | enhancing and transforming images in preparation for subsequent analysis |
| **Intensity Checker** | analyze an object using image intensity |
| **Blob Analysis** | identify, count, locate and measure basic features and objects (blobs) |
| **Edge Locator** | find objects by locating straight edges |
| **Metrology** | 2D geometric dimensioning and tolerancing |
| **Code Reader** | locating and reading 1D, 2D and composite identification marks |
| **String Reader** | reading character strings that are engraved, etched, marked, printed, punched or stamped on surfaces |
| **Pattern Matching** | techniques to find an object using grey-levels |
| **Model Finder** | patented five techniques to find an object using geometric features (e.g., contours) |
| **Bead Inspection** | analyze beads |

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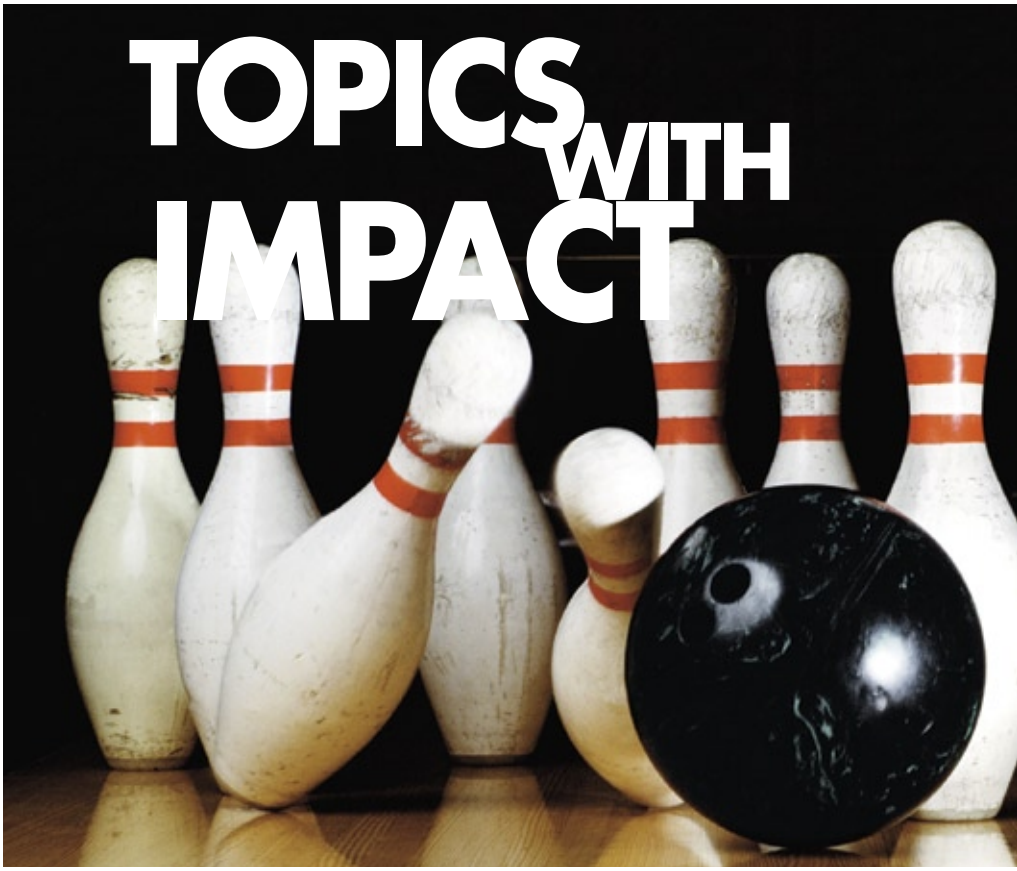
# Topics with Impact:
# All You Ever Wanted to Know about 3D

## 3D Vision and 3D Metrology in the INSPECT Panel Discussion

**The European Market Data Report on machine vision recently published by the EMVA, European Machine Vision Association, documents it: 3D technologies are on the rise. In 2008 already close to 10 % of the total sales of application specific machine vision systems (ASMV) out of Europe has been generated with 3D metrology. In this number the sales of 3D robot vision, 3D inspection and 3D identification is not even counted. The American machine vision association AIA even determined the share of 3D-based systems among all ASMVs sold in North America in the range between 13 % and 15 %.**




Also the Vision, international leading trade show for machine vision, taking place in Stuttgart from November 3rd to November 5th, will show this. Not only will we see a whole range of new 3D-based products from the established suppliers of components, products and system solutions, but we will also see quite a few new players with a clear dedication to this field.

3D technologies is a generic term for a very wide field of methods, sensors, algorithms and applications. Compared to the traditional 2D technologies of machine vision they come with an additional level of complexity, additional hardware requirements and more often than not also at additional cost. What then is the additional benefit for the user, which technology is the best for which application, what is state-of-the-art today and what more can be expected in the future? Will machine vision technologies find their way into traditional 3D metrology, today still dominated by coordinate measurement machines? Will the 3D metrology suppliers expand their portfolio towards inline measurement in production?

These and more questions will be addressed by the INSPECT in a panel discussion with leading experts from 3D machine vision and 3D metrology. In the framework of the Industrial Vision Days, organized by VDMA (German Engineering Federation) during the Vision trade show, the following panelists will share their expert opinion with you:

### Dr. Wolfgang Eckstein, MVTec Software

Dr. Wolfgang Eckstein is co-founder and managing director of MVTec Software GmbH in Munich, Germany. After obtaining a PhD in Computer Sciences from the Technical University of Munich he initially stayed on as assistant scientist, but then founded in 1996 together with Dr. Olaf Munkelt the company MVTec. From 1996 until 2000 Dr. Eckstein was Chairman of the working group „Image Understanding/Object Recognition“ of the International Society for Photogrammetry and Remote Sensing and in the year 2000 he received the Talbert Abrams Award of the American Society for Photogrammetry and Remote Sensing. In both of the years 1986 and 1991 Dr. Eckstein was awarded by the Deutsche Gesellschaft für Mustererkennung (German Society for Pattern Recognition).

MVTec Software GmbH is a leading international manufacturer of software for machine vision, and the developer and vendor of the machine vision standard software Halcon. This tool, optimized for the needs of OEMs and system integrators, enables engineers to set up their own solutions for a specific machine vision task. Halcon serves all industries by a library of more than 1,400 operators for blob analysis, morphology, pattern matching, measuring, and identification, e.g. With methods for Perspective Matching, Multigrid Stereo, Sheet-of-Light Measurement and 3D Camera Calibration Halcon provides a comprehensive software portfolio for fast and sound solutions for highly demanding 3D vision challenges. MVTec has more than 30 established distributors, located throughout Europe, North- and South-America, Australia, and Asia. In addition, MVTec, LLC works out of Boston, MA (USA).

**Dr. Heiko Frohn, Vitronic**

Dr.-Ing. Heiko Frohn studied electrical engineering at Darmstadt Institute of Technology and was subsequently awarded a doctorate in the field of machine vision at Ruhr University in Bochum. Dr. Frohn has been working for Vitronic since 1986 and currently is the Managing Director and head of the Industrial Automation Division.

Vitronic is a medium-sized and owner-operated company. Since its formation in the year 1984, the company has grown without assistance. Today, Vitronic is represented on four continents and counts as one of the world's leading companies in the field of machine vision. The company provides everything from standard products with modules that can be expanded according to customer specifications to individualized special solutions. Vitronic looks back on many years of experience with 3D measuring techniques that are used in various fields: in traffic technology, exact vehicle classification forms the basis for correctly collecting tolls and for monitoring traffic. In intralogistics, postal operators and mail order companies utilize 3D measuring techniques in order to check paid parcel postage, to automatically prepare invoices and to optimize the loading of vehicles. In the field of industrial automation, 3D measuring techniques are used for implementing the identification and handling of complex and dimensionally unstable part geometries. Another field of application is the three-dimensional inspection of welding seams. 3D measuring techniques are also used for body scanning. The obtained information makes it possible to produce custom-tailored clothing, to ergonomically design automobiles and to carry out training controls for athletes.

**Dr. Mats Gökstorp, Sick**

Dr. Mats Gökstorp is a member of the Management Board of Sick AG and responsible for the Advanced Industrial Sensors Division. After finishing his doctorate Mats Gökstorp joined the small innovative Swedish vision company IVP. IVP is one of the pioneers within 3D machine vision and has developed a range of high performance 3D cameras based on a unique imaging ASIC. He spent the following years developing IVP from a three persons operation to a 40 persons company with sales in Europe and North-America. After 2003 he managed the integration of IVP into the Sick group and took over the Advanced Industrial Sensors division in 2007.

Sick is one of the world's leading producers of sensors and sensor solutions for industrial applications. For decades, Sick has ranked among the most innovative enterprises globally in the sensor industry. The latest technological insights and methods are implemented into innovative products and system solutions. With the combination of high end 3D vision technology and industrial sensor technology Sick is making 3D vision solutions available for a broad range of industrial applications, from automotive and packaging industries to logistics distribution centres. The focus on connectivity and easy-to-use creates superior customer benefits. By making vision sensors as easy to use as standard photoelectric sensors customers can focus on the solution instead of implementing technology. Innovation creates a broad range of sensors and sensor solutions which position Sick as a technological and market leader in the customer segments of factory, logistics, and process automation.

**Per Holmberg, Hexagon Metrology**

Per Holmberg joined the group in April 2004 as President of Hexagon Metrology Europe. His responsibility involves both the commercial and the manufacturing operations of all Hexagon Metrology factories in EMEA. All activities are closely integrated within the Hexagon Metrology organization, worldwide.

Hexagon Metrology is part of the Hexagon AB Group and includes leading metrology brands such as Brown & Sharpe, CE Johansson, CimCore, CogniTens, DEA, Leica Geosystems (Metrology Division), Leitz, m&h Inprocess Messtechnik, PC-DMIS, Quindos, Romer, Sheffield, Standard Gage and Tesa. Hexagon Metrology brands represent an unrivaled global installed base of millions of Coordinate Measuring Machines (CMMs), portable measuring systems and handheld instruments, and tens of thousands of metrology software licenses. Hexagon Metrology empowers its customers to fully control manufacturing processes that rely on dimensional precision, ensuring that products manufactured precisely conform to the original product design. The company offering of machines, systems and software is complemented by a wide range of product support, aftermarket and value-added services.

**Len Metcalfe, LMI Technologies**

Leonard Metcalfe is the Chairman of LMI Technologies. Prior to this Mr. Metcalfe as the Chief Executive Officer used his over 33 years experience working with 3D/2D sensor technology and process optimization to lead LMI. Mr. Metcalfe was the driving force in merging the various companies to form LMI in 1997. In 1976, he co-founded Dynamic Control Systems, Inc. and was personally involved in designing many of the company's earlier products. Mr. Metcalfe received his Diploma of Technology in Control Electronics from the British Columbia Institute of Technology in Vancouver, Canada. He is a member of the SME (Society of Manufacturing Engineers) and the SPIE (International Society of Optical Engineers).

LMI Technologies is a leading global provider of 3D/2D sensor technology for original equipment manufacturers and systems integrators. Customers from diverse industries engage LMI to develop and deliver sensors for numerous automated vision, control, and measurement applications. Since 1976, over 50,000 LMI "Sensors That See" have been put to work by LMI partners in some of the harshest working environments imaginable. As a key player in sensors based on machine vision technology, LMI continues to add to its over 100 technology patents. The LMI organization represents a talented group of people, working hard to engineer the best 2D and 3D sensor technology available today. The solutions developed with partner OEMs and integrators continue to leverage the compa-

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### Dr. Christian Wöhler, Daimler

Christian Wöhler received the Diploma in Physics from Würzburg University in 1996, the Doctorate degree in Computer Science from Bonn University in 2000, and the Habilitation (Venia Legendi) in Applied Informatics from Bielefeld University in 2009. He is working as a senior research scientist in the Environment Perception department of Daimler Group Research and Advanced Engineering in Ulm. Since 2005 he is a visiting lecturer in the Applied Informatics Group at the Faculty of Technology of Bielefeld University. His scientific interests are in the domains of 3D computer vision, photogrammetry, and pattern classification, with applications in the fields of driver assistance systems and industrial machine vision. He is author of more than 60 scientific publications. Recently, his monograph „3D Computer Vision – Efficient Methods and Applications" has been published.

Daimler is a globally leading producer of premium passenger cars and the global market leader of heavy- and medium-duty trucks as well as buses. The department of "Environmental Perception" is concerned mainly with the development of analysis methods for sensor-based driver assistance systems, especially in the area of stereoscopic vision, radar signal processing and pattern classification. Additionally 3D image processing methods for applications in industrial metrology and quality control as well as in safe human-machine interactions are developed. The latter were implemented, e.g., in the "SafetyEye" system, the first commercially available certified 3D vision system for the safeguarding of machines in production environments, which was developed jointly with an external cooperation partner.

The INSPECT panel discussion will take place on November 4th, 2 p.m.–3 p.m. in the Forum Industrial Vision Days at Neue Messe Stuttgart.

More information on products, systems and solutions from the area of 3D technologies can also be found in the next issue of the INSPECT. This issue 11 will be published in mid November and will feature a special focus on "World of 3D."


**Contact**

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# Get more vision


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- Factory communications
- Protective enclosure
- Developer and Operator interfaces

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Visit DALSA at VISION 2009, Stuttgart, Germany, November 3-5, Hall 4, Stand D53 to see a live demonstration of the BOA Vision System.

DALSA


# BOA Vision System

| SPECIFICATION | DEFINITION | |
|---|---|---|
| Memory | Storage | 256MB |
| | Program | 256MB |
| Image | Sensor | 1/3 inch CCD |
| | Pixel size | 7.4 µm |
| | Resolution | 640x480 |
| | Type | Mono or Color Progressive Scan |
| | Exposure | 22 us to 1000 ms |
| | Acquisition | Async Reset, full-frame integration |
| | | 60 f/s maximum (application dependent) |
| | Lens | C Mount (lens cover optional) |
| | Lamp | Direct connect (Pwr/Gnd/Strobe) |
| I/O | Trigger | 1 opto-isolated input |
| | | Software trigger via Ethernet or internal timer |
| | Inputs | 1 General purpose opto-isolated |
| | | Expandable via Ethernet I/O |
| | Outputs | 2 General purpose opto-isolated |
| | | Expandable via Ethernet I/O module |
| | Strobe | 1 dedicated strobe output for LED light source |
| | Status | Network + 2 application assigned LEDs |
| Serial | RS232 | Flying leads from M12 cable |
| Network | Ethernet | 10/100 BaseT (Supports “passive Power over Ethernet”) |
| Power | 12-30V | Via I/O or Ethernet |
| Mechanical | Material | Machined Aluminum with anodize/paint finish |
| | Mounting | 8 x M 4 plus optional mounting block |
| | Size | 44mm x 44mm x 56mm (without lens cover) |
| Environment | Temp | -10°C (14°F) -50°C (122°F) Operating (-60°C - 80°C Storage) |
| | Protection | IP67 with cables attached |
| | Shock | 70 G |
| Certification | | FCC Class B and EU CE |

MORE VISION

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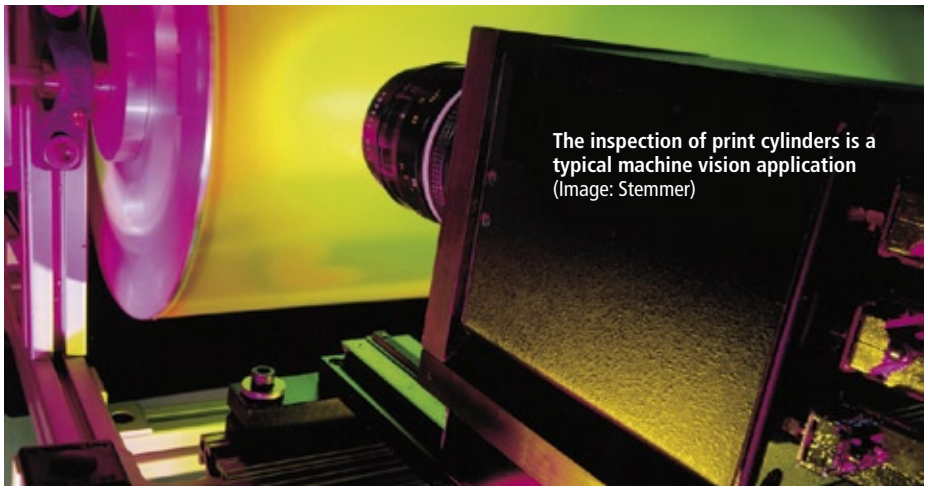
DALSA

# Looking Ahead

## New Machine Vision Solutions and Trends at Automatica 2010



The inspection of print cylinders is a typical machine vision application (Image: Stemmer)

Measurement values in connection with statistical analyses provide options for process control and optimization (Image: Rohwedder)

3D welding seam inspection is the basis for process optimization and automated repair (Image: Vitronic)

**Vision systems provide eyes to robots so that these can carry out targeted movements precisely. Naturally it would be best if they could see 3D. These and other aspects of automation of production processes by machine vision products, systems and solutions are presented every other year at Automatica. The upcoming event is taking place in June 2010.**

The domain of machine vision has long since grown out of the first dedicated quality control tasks. The advantages of these systems are obvious: They work without getting tired, if necessary 24 hours a day, even at high production speeds and conditions that would be hazardous to human health. Systems having been developed for easier operation open up a whole new range of applications and quite some users are rethinking their approach. They are acquiring corresponding know-how themselves to gain a competitive advantage by employing machine vision in their production or machine. Peter Stiefenhöfer, Marketing Manager of Stemmer Imaging says "The user structure is changing in this area, and machine vision is increasingly becoming a generally used technology." In addition to the increased use of "one-button" systems also the distribution of highly complex machine vision systems experiences growth. Here, several networked machine vision systems are employed, e.g., which monitor and document the individual process steps for a number of production lines. Statistical analysis of the gathered data provides the chance to obtain additional knowledge about the process and its weaknesses. In this way machine vision opens up new possibilities for process optimization and cost reduction.

### Preparation for the Automatica

Interested professionals will find a great variety of information at Automatica 2010, the leading international trade fair for automation and mechatronics. The trade show will take place on the grounds of the New Munich Trade Fair Centre from 8 to 11 June 2010. The core areas represented are assembly and handling technology, machine vision and robotics. From the area of machine vision, application fields for components, new product generations (e.g., cameras, sensors and frame grabbers), software solutions and application specific turn-key systems will be presented. The main customer industries are mechanical engineering as well as the automobile and electronics industries. Overall, Automatica provides an exhibition program orientated to actual practice as well as a lecture forum where aspects of machine vision are discussed in detail. Since machine vision has become so multi-faceted today, making it difficult for especially new users to obtain an overview, the German Engineering Federation (VDMA) is providing support. Manufacturers, suppliers and service suppliers of machine vision joined together in the Machine Vision department, which belongs to the VDMA Association Robotics + Automation, the conceptual sponsor of the Automatica. To support users, the federation has published a business directory for the industry in German and English, a manufacturer index, as well as a database with application reports which is available on the Internet. Patrick Schwarzkopf, the contact person at VDMA for machine vision, explains: "Many users contact companies directly via these media, and others contact us with in part very concrete questions. Then we search for suitable suppliers, who have special skills in the requested areas and establish contacts to them."

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# Relaxed Technical

## Kappa Summer Symposium in Northeim


**"What's up here?" The taxi driver who brought me to the idyllically situated "Waldhotel Freigeist" in lower Saxony Northeim was visibly surprised. Obviously he had never seen the hotel parking lot this crowded, with licence plates from all over Germany and the neighboring countries. No surprise though for the initiated: the camera manufacturer Kappa had invited to their annual summer symposium.**

"Relaxed technical" was the slogan of the customer and partner event, hosted by Kappa for the third time now. This is certainly an unusual motto for a customer day; and unusual was also the start. Kappa had invited their guests already on the eve of the actual symposium to meet at brilliant weather and excellent food for relaxed technical or just relaxed chats, to cultivate existing contacts and to establish new ties. In his welcome speech, Kappa CEO Jürgen Haese pointed out with a wink that the crisis takes place mainly without the participation of Kappa, and he thanked his customers for this. The lively evening was crowned by a presentation sparkling with energy and enthusiasm delivered by the director of the Göttingen-based XLAB (www.xlab-goettingen.de), Dr. Eva-Maria Neher. XLAB, the Göttingen Experimental Laboratory for Young People, aims to bridge the gap between scientific research and school teaching and offers ambitious practical experiments and courses in biology, chemistry, physics, geosciences and computer science for school students and teachers. The young students have the opportunity to carry out challenging and relevant experiments and work closely together with highly qualified scientists. In this way young people can be motivated to take an interest in science that might lead to the decision to take this on as a profession. The work of Dr. Neher is inspiring, and it also inspires the management of Kappa, who is a sponsor of the XLAB.


The actual symposium the following day was a well-balanced mixture of presentations and workshops. The opening speech was given by Jürgen Haese and pointed out the new portfolio strategy of the 100 people strong camera manufacturer: with long-lasting partnerships and focusing on customer series new solutions with manageable technology will be implemented, following the mission statement of the company: realize visions. Following this introduction, Technical Director Axel Zimmer presented Kappa's new development areas under the headline "Courage for Technics". New features can mainly be expected in the areas of


sensors, processors (included an embedded Linux), and with the camera functionalities of image data compression, digital zoom and correction of optical characteristics. The interface question is answered by Kappa with GigE/Gen<i>Cam und USB. Alexander Berg, Sales and Marketing Manager at Kappa since a couple of months now, then presented the new team structure of the company. Different cross-disciplinary teams with diverse focus areas will ensure that the company's treatment of customer wishes is not only "relaxed" but also successful for all parties involved. The customers in the audience seemed to wholeheartedly confirm that this already works. The next presentation was given by Dr. Bernd Schlichting from the Electronics Development, who presented the Kappa HDTV technology; a topic that was dealt with in more detail also in one of the workshops later on. The program of presentations was rounded up by a talk about the current market data and the future perspectives for machine vision by Patrick Schwarzkopf, VDMA.

In the second part of the symposium the attendees had a choice between two workshop blocks. It was not an easy choice between topics as interesting as HDTV/3D cameras or camera measuring and GigEVision/Gen<i>Cam or High Dynamic Range cameras, respectively. The technical experts from Kappa managed to convey these sophisticated topics with great technical competence and good didactic skills. The symposium ended after a joint lunch with the offer to either visit the Kappa premises in Gleichen or the XLAB in Göttingen.

In summary, the Kappa customer day was of high technical ambition – and very relaxed. The guests enjoyed both.

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# Bright Prospects

## Vision 2009 ties in with Previous Successes

**The outlook of Vision 2009, leading international trade show for machine vision and identification technologies in Stuttgart, is bright despite the current difficult times. About 280 exhibitors will be present, 42 % of those from outside of Germany. As in 2008 the exhibitors present themselves in hall 4 and hall 6 on 20,000 m² gross floor space. With these numbers the Vision is likely to be one of the few trade fairs this year matching the results of the previous year.**

The Vision is a meeting-point, marketplace and driving force for the machine vision industry and the world's most important forum for the exchange of information between exhibitors, trade visitors, research institutes, trade associations and universities.

Components, products and systems will be shown at the leading international trade show for machine vision and identification technologies. About 70 % of all exhibitors will focus on components and products, about 40 % of the exhibitors will show systems and turn-key solutions. One in three exhibitors also presents application examples from the field on their stand. The range of exhibits includes cameras, frame grabbers, optics and lighting solutions, processors, software tools, cabling and interfaces, as well as system solutions and services.

We managed to compile some of the upcoming highlights and present those to you as a peak-preview of sorts on the following pages.

Innovations and new products are only one part of the trade show portfolio, how-

ever. Both exhibitors and visitors cherish the comprehensive accompanying programme geared towards the needs of the users.

### Forum Industrial Vision Days

In particular, the Industrial Vision Days under the direction of the Machine Vision Group in the German Engineering Federation (VDMA) is becoming more and more popular every year. This three-day series of German and English language talks featuring more than 40 speakers provides manufacturers, users and scientists with an ideal forum for presenting new technologies and products, innovative applications and results of research and scientific work. The range of topics during the Industrial Vision Days ex-tends from economic questions through to the right choice in the interface jungle or the best solution for measuring and inspection tasks using 3D systems. Last year around 2,700 visitors to the trade fair were interested in the Industrial Vision Days. One of the highlights for the visitors last year has been the panel discussion "Machine Vision and Security". More than 200 visitors were present at this event. This year's panel discussion is again greatly in line with the current trend: "All you ever wanted to know about 3D: Technologies, Applications, Trends". We present the participants of this top-notch panel in a separate section of this issue.

The Industrial Vision Days forum is located in hall 6 and without any barriers directly integrated into the main trade show activities. Visitors can join their individual choice of presentations free of charge. You'll find the complete program of this series of talks on the following pages for your preparation.

### Industrial Vision Award

Innovations are the driving-force behind an industry, especially behind an industry like machine vision which generates time and again potentials for automation, quality optimization and cost reduction in industrial applications by implementing cutting-edge technologies. And because it is often small companies which have high innovation potential, Vision will honour this for the 17th time this year with the Vision Award for Applied Machine Vision. This Prize is awarded for innovative products, system solutions or processes which are pioneering for the machine vision industry. A jury comprised of industry experts decides which of the submitted entries wins. The

# Industrial Vision Days, Hall 6 Booth A81

## Tuesday, November 3rd

9:15 a.m. Der Markt für Industrielle Bildverarbeitung in Deutschland
*VDMA, Patrick Schwarzkopf*

9:30 a.m. High resolution and high speed CMOS sensors for machine vision applications, with novel pixel allowing CDS operation in pipelined global shutter operation
*CMOSIS, Pieter Willems*

10:00 a.m. How factory automation is evolving and reshaping today's industrial vision solutions
*Dalsa, Steve Geraghty*

10:30 a.m. Infrared in machine vision – From shortwave line-scan array to longwave 2D bolometer camera
*XenICs, Martin Ghillemyn*

11:00 a.m. 3D Eye – intelligente 3D Kamera basierend auf Lasertriangulation
*EVT Eye Vision Technology, Michael Beising*

11.30 a.m. Produktionsoptimierung durch Bildverarbeitung – Beispiele aus der Praxis
*Fanuc Robotics, Frank Schwabe*

12:00 a.m. Why designing a custom digital camera in-house may increase costs and time to market
*Lumenera, Steve McSherry*

12.30 a.m. CMOS image sensors and cameras optimized for machine vision – why bother?
*Photonfocus, Chris Softley*

1:00 p.m. NanEye-Worlds smallest digital camera module!
*Awaiba, Stephan Voltz*

1:30 p.m. Prototyp eines Vision-Sensors in 28 Tagen – von der Idee bis zur Fertigstellung
*MaxxVision/LMI, Cor Maas*

2:00 p.m. Multisensor-Lösungen zur Roboterführung für Montage und Logistik
*VMT Vision Machine Technic, Dr.-Ing. Stefan Gehlen*

2:30 p.m. The great interface debate: are we done yet?
*Point Grey Research, Vladimir Tucakov*

3:00 p.m. e2v Machine vision solutions
*e2v, Sebastien Teysseyre & Gareth Powell*

3.30 p.m. Practical experiences with the EMVA 1288 standard
*EMVA, Prof. Dr. Bernd Jähne*

4:00 p.m. Back to the future – coax cable to lead the way for digital camera connectivity
*Adimec, Jochem Herrmann & Chris Beynon*

4.30 p.m. Correcting non-uniformity defects and chromatic aberrations
*Lord Imaging, Franck Monin*

## Wednesday, November 4th

9:15 a.m. The European Machine Vision market
*EMVA, Andreas Breyer*

9:30 a.m. Smart Applets – off-the-shelf application processing
*Silicon Software, Michael Noffz*

10:00 a.m. HDTV für industrielles Fernsehen und Bildverarbeitung
*Kappa, Dr. Bernd Schlichting*

10:30 a.m. More than just cameras – The complete solution for GigE Vision
*Baumer Optronic, Jens Klattenhoff*

11:00 a.m. CVB GigE Vision-Server – and the PC turns into a camera!
*Stemmer Imaging, Peter Keppler*

11:30 a.m. USB 3.0 – Hintergründe, Neuerungen und Einsatz als Kameraschnittstelle
*IDS, Daniel Seiler*

12:00 a.m. Neue Hochgeschwindigkeitskameras mit 3 Megapixel Auflösung
*Mikrotron, Bernhard Mindermann*

12.30 a.m. 3D-Kamera: Universaltalent für innovative Vision Integration
*ifm electronic, Mike Gonschior*

1:00 p.m. Serverbasierte Bildverarbeitung – Mehr Intelligenz für die Kamera
*Matrix Vision, Uwe Furtner*

1:30 p.m. GenICam – the standardized unified programming interface for cameras
*EMVA, Dr. Friedrich Dierks*

2:00 p.m. Panel Discussion:
All you ever wanted to know about 3D – Technologies, Applications, Benefits
*Dr. Wolfgang Eckstein, MVTec*
*Dr. Heiko Frohn, Vitronic*
*Dr. Mats Gökstorp, Sick*
*Per Holmberg, Hexagon Metrology*
*Len Metcalfe, LMI Technologies*
*Dr. Christian Wöhler, Daimler*
*hosted by Gabriele Jansen, INSPECT*

3:00 p.m. Der Weg aus der Krise: Hoher Kundennutzen durch Standard-Software für die IBV
*MVTec, Dr. Olaf Munkelt*

3:30 p.m. Easy 3D calibration of laser triangulation systems
*SICK IVP, Fredrik Nilsson*

4:00 p.m. Customization without compromise: tailoring general-purpose GigE Vision solutions to single-purpose applications
*Pleora, Rob Lee*

## Thursday, November 5th

9:15 a.m. Der Markt für Industrielle Bildverarbeitung in Deutschland
*VDMA, Patrick Schwarzkopf*

9:30 a.m. Improved light sensitivity in color CCD image sensors using the Kodak Truesense color filter pattern
*Eastman Kodak, Michael DeLuca*

10:00 a.m. 2D/3D HexSight smart sensor for part inspection and robot guidance
*LMI Technologies, Glenn Hennin*

10:30 a.m. Hochpräzise 3D-Messtechnik mit intelligenter 3D-Kamera
*SmartRay, Mathias Reiter*

11:00 a.m. GigE Vision: Focus on next generation cameras in low-cost applications
*Basler, Henning Tiarks*

11:30 a.m. Streifenprojektion – Neuer Ansatz für Standardbildverarbeitungssysteme zur 100%-Kontrolle von diffusen Oberflächen
*SAC, Alexander Piaseczki*

12:00 a.m. Warum embedded? Von Bildverarbeitungs-Systemen zu Bildverarbeitungs-Produkten
*Imago Technologies, Carsten Strampe*

12.30 a.m. SAL3D enables fast, accurate and reliable 3D machine vision applied to the food processing industry
*Aqsense, Dr. Josep Forest*

1:00 p.m. Vier Sensoren, zwei Verarbeitungswege, eine Kamera – Optisches 3D-Tracking kombiniert mit Head-Mounted Stereo-See-Through-Kamera
*VRMagic, Dr. Markus Schill*

1:30 p.m. 3D-MaMa: 3D pose estimation for random bin picking by pairwise manifold matching
*Tordivel, Thor Vollset*

2:00 p.m. VC Solar Solution: Hochgenaues Positionieren und Kantenbruchkontrolle von Solar Wafern mit Standardkomponenten
*Vision Components, Michael Engel*

2:30 p.m. Cypress introduces a new standard image sensor: Vita 1300
*Cypress Semiconductor Corporation, Tom Walschap*

3:00 p.m. Null-Fehler-Strategie – Automatisierte 100%-Kontrolle von Oberflächen – ein Anwendungsbeispiel
*OBE, Dr. Christoph Wagner*

3:30 p.m. The ARTTS Project – New time-of-flight technology and applications
*University Lübeck, Martin Böhme*

4:00 p.m. Intelligente Video-Technologien des AIT Austrian Institute of Technology
*AIT, Bernhard Strobl*

4:30 p.m. Indium-Gallium-Arsenid (InGaAs)-Bildsensor-Hybride für industrielle Anwendungen
*Andanta, Christian Lochmann*

Vision Award is traditionally bestowed upon the winner at the evening of the first trade show day.

### Presentation of Machine Vision Standards

As in 2008 again this year the three machine vision associations EMVA, JIIA and AIA will present the current status of the standards they endorse in a special exhibition. The visitor will get an introduction to and demonstration of the camera standard EMVA 1288, the interface standards GigE Vision and Gen<i>Cam and the lens mount standard.

### Vision Academy: Beginners' Seminar for Newcomers

After the positive start in 2008, the Vision Academy will also contain a range of workshops this year, aimed especially at newbies and first-time users of machine vision. The workshops take place daily between 11 a.m. and 3 p.m. with a new topic every full hour. The range of topics covers basic aspects like illumination methods and effects and the choice of the right optical lens as well as applications like robot guidance and thermography and even encompasses an introduction into programming of smart cameras with OpenCV.

## Key Topic: Systems and Applications

What started with the "Automotive Application Park" in 2008 will now be extended still further this year. Vision wants to give system integrators a better platform and therefore set up a specific "Integration Area" this year in hall 4 where system solutions can be presented 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 INSPECT supports this initiative and has become the sponsor of the Vision Integration Area. You find more information on this initiative and the exhibitors in this section in a dedicated report in this issue.

Anyone who ever wanted to know about the interaction between robots and vision systems in a production line will be able to experience this exemplary for the second time during the "Automotive Application Park". Under the motto "Partners for Vision 2009, watch with ease!", around 20 companies from the machine vision and automation industries have set up a modular test system for toy cars on a scale of 1:87 covering an area of 220 m². The real industrial processes will be presented here 'interactively in a playful way.'

## A Chance for Young Scientists: The Youth Research Competition "Jugend forscht"

Participants in the "Jugend forscht" initiative will take part in Vision for the first time with their own exhibition stand and will present award-winning projects whose topics relate to machine vision. A professional sorting machine for dice-shaped workpieces made of different materials will be displayed as well as a 3D computer mouse for graphics applications making use of the third dimension. These are genuine technical highlights which will be presented by 17-to 20-year-old school students.

## International Trade Show Location

The visitor target groups for Vision include for more than 20 years now managing directors, senior executives, purchasers, planners, designers, developers and production and maintenance engineers and technicians from the main user industries, i.e. mechanical engineering, the car industry and the electrical engineering industry. However, Vision is also aimed at users from countless other industries such as the agricultural industry, biotechnology, the chemical industry, the printing industry, the precision mechanics and optical industries, glass manufacturing, the rubber/plastics/foil industries, wood processing, the aerospace industry, medicine, microscopy, the food industry, the pharmaceutical industry, the cosmetics industry, security technology and biometrics, telecommunications, the textile and clothing industry, and transport and logistics.

One of the biggest benefits for Messe Stuttgart as the platform of an internationally leading trade show as the Vision is the superb location next door to Stuttgart Airport. It is only a five-minute walk for visitors from the airport terminal to the exhibition halls. Furthermore the New Stuttgart Trade Fair Centre is located directly at the highway, and connected via local fast train to the main train station in Stuttgart centre. All three connections make sure that a visit to the Vision can be accomplished as one-day-trip for most of the European visitors. Especially in these times this is highly appreciated.

The Vision trade show takes place from November 3rd to November 5th at Neue Messe Stuttgart, directly in front of Stuttgart airport. Opening hours are 9 a.m. to 5 p.m. INSPECT readers have free access to the show.

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## Green Powerline Laser

Stockeryale's Lasiris thermoelectrically cooled green powerline laser was one of the high-lights at this year Laser show "World of Photonics" in Munich. Green Powerline structured light laser offers a thermoelectric system and fan that maintains a constant laser diode temperature, resulting in better wavelength, power, and pointing stabilities. The Green Powerline design makes focusing even easier with the focus adjusting screw located directly on the body of the laser. A green beam can provide better contrast on red hot metal or wood. Another advantage is that a green beam is more visible to the human eye than red, there by making the relative eye response to the green much higher. For the same power, a green beam (532 nm) will be better perceived by the human eye than a red beam (635 nm). Applications are hot steel inspection, glass inspection, outdoor applications, positioning, R&D.

**Vision: Hall 4, Booth C11**

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*Tel.: +49 8153 405 0 · info@laser2000.de · www.laser2000.de*

## Standard 3D Processing Library Provides Higher Yields


Aqsense, software manufacturer and 3D solution provider, presents the new version of the 3D Shape Analysis Library at Vision 2009. SAL3D constitutes the first standard commercially available modular software library for 3D machine vision applications, being completely hardware independent. The handled data type consists of point cloud coordinates, which are real floating point scalars characterizing the three axis X, Y and Z. The standardization of this framework permits the synergistic integration of available digitizing technologies and configurations like laser triangulation with single or multi camera set-ups, stereo vision, Time of Flight devices, and other sources of organized sets of points with a CoP (Cloud of Points) processing software. The result is an extremely accurate and precise 3D digital model.

**Vision: Hall 4, Booth B79**

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

## Vision Applications Benefit from Custom Lenses

While off-the-shelf lenses may be suitable for some applications Resolve Optics specialises in design and development of bespoke optical systems that meet the requirements of demanding machine vision applications. These demands include covering large format sensors that offer greater resolution, large apertures to ensure the maximum use of the light available, wide fields of view with little or no distortion, Optical designs and coatings that are balanced to give best performance at a desired wavelength or waveband and compact design as space is often at a premium. In short Resolve Optics offer machine vision camera suppliers and systems integrators the opportunity to achieve full performance potential, gain competitive advantage and ensure security of supply over a critical system component.

**Vision: Hall 6, Booth 85**

*Resolve Optics Ltd.*
*Tel.: +44 1494 777100 · sales@resolveoptics.com · www.resolveoptics.com*

### Point Grey to Unveil Innovations

Point Grey's commitment to technology leadership and product excellence – summed up by the company's tag line „Innovation in Imaging" – forms the basis for their presence this year at Vision 2009. On more than 100 m², many of Point Grey's existing camera products will be running live and on display, including the versatile Flea2, the world's smallest IEEE 1394b camera; the Firefly MV and Chameleon USB 2.0 cameras, known for their small size and low cost; and the high performance Grasshopper, featuring a wide selection of high resolution, high sensitivity sensors. Visitors can also look forward to the introduction of a new Point Grey camera family, the debut of several new image sensor options, and the expansion of the company's digital interface offerings, with details to be unveiled at the show.

**Vision: Hall 4, Booth A31**

*Point Grey Research Inc.*
*Tel.: +1 604 2429 937 · info@ptgrey.com · www.ptgrey.con*

### Smart Cameras Powered by Intel Atom

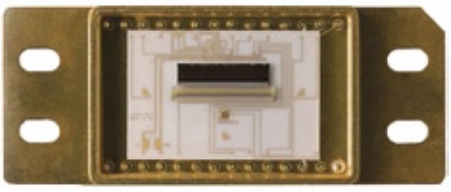
Softhard introduces the Currera line of smart cameras powered by Intel Atom with full range of CCD and CMOS sensors up to 24 x 36 mm 16M Kodak CCD. The optical mounts including standard C-mount and active Canon lens mount with complete lens control. Exceptionally small enclosure measuring only 70 x 70 x 94 mm for top of the line 24 x 36 mm Kodak 16M CCD Canon mount model, coming with PoE Gigabit Ethernet, USB, isolated GPIO ports, MicroSD card storage and much more. Ready to run Linux, Windows XP or XP embedded from onboard SSD the time for real life application deployment can be measured in minutes. All of this is coming with legendary Softhard's scientific grade image quality, up to 70 dB signal/noise ratio, color versions with advanced moiré free demosaicing and color reproduction of small details.

**Vision: Hall 4, Booth B13**

*Softhard Technology Ltd.*
*Tel.: +421 2 6545 9327 · info@softhard.com · www.softhard.com*

### Peltier-Cooled Multiplexed Arrays

CAL Sensors has extended its range of multiplexed 256-element arrays with the addition of new Peltier-cooled products ideally suited to thermal imaging applications. The new arrays feature 40 µm x 40 µm pixels with a pitch of 50 µm. Both PbS arrays, with a spectral range of 1–3 µm, and PbSe versions (1–5 µm) are now available. These devices feature spectral response to longer wavelengths than traditional InGaAs arrays, enabling objects with lower temperatures to be detected. The arrays allow data read-out at up to 4 MHz, and pixel groups can be read-out individually. The new LIRA5S-Arrays are available now from Laser Components.



**Vision: Hall 4, Booth C72**

*Laser Components GmbH · Tel.: +49 8142 2864 0*
*info@lasercomponents.com · www.lasercomponents.com*


# VISION 2009

22nd International Trade Fair for Machine Vision and Identification Technologies

**Messe Stuttgart Halls 4+6**
**3 to 5 November 2009**

With VISION Integration Area & Application Park

Do you want your production processes to be faster and more secure? Do you want to reduce your error ratios and minimise rejects? Do you want to manufacture at a more reasonable cost and improve your products?

## Then you are a VISIONARY, too!

Optimise your quality assurance by using intelligent machine vision systems. VISION, the world's leading trade fair for machine vision and identification technologies, will be presenting solutions for a number of industries such as machine building, the automotive industry, the packaging and food industry, transport and logistics, security technology and much more. In the Application Park and the VISION Integration Area, we will be showcasing state-of-the-art system solutions and innovative machine vision applications.

***www.vision-messe.de***

## Powerful Light Sources

Leistungselektronik Jena is adding another five models to LQ HXP 120, the family of powerful light sources launched in 2007. The LQ ME 200 and the LQ MH 200 DC put double irradiance with optimal coupling and long life of the lamp at the user's disposal. Both light sources are available in a VIS and an UV version. In comparison with AC short-arc lamps, the internal DC supply of the LQ MH 200 substantially reduces the time-related fluctuations of the light current while at the same time long-time stability has been improved. This makes the lamp extremely suitable for quantitative fluorescence microscopy and other time-critical applications. The IR radiation exposure of the connected illumination systems is substantially reduced by the selective effect of the lamp reflector and an integrated heat protection filter, even with the higher lamp output ratings.

**Vision: Hall 4, Booth D13**

*Leistungselektronik Jena GmbH · Tel.: +49 3641 3530 0 · info@lej.de · www.lej.de*

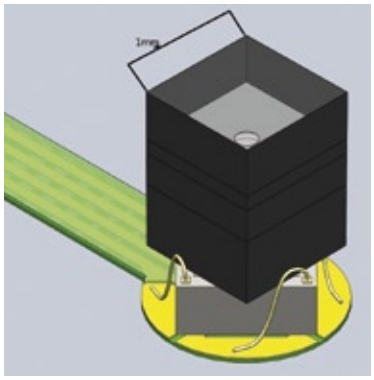
## Smart Applets for Applications

Silicon Software delivers SmartApplets hardware programming as partial solution for applications for its V-series frame grabbers. SmartApplets is different to onboard image enhancements or image corrections. It covers complex image preprocessing, segmentation or classification tasks, which are processed on the board FPGA in real-time and with a high algorithmic quality. Hereby applications are tremendously accelerated and the load of the host CPU significantly reduced. SmartApplets will constantly be extended and improved. Available partial solutions are among others: object segmentation with Blob analysis, application pre-stage with complex adaptive threshold, classification by huge color lookup tables, compression on single images or even profile processing for measurement applications by laser triangulation method.

**Vision: Hall 4, Booth D72**

*Silicon Software GmbH*
*Tel.: +49 621 789 507 0 · info@silicon-software.de · www.silicon-software.de*

## Digital Camera Can Support Long Cables



With the NanEy image sensor family Awaiba enables high resolution vision in space limited applications, such as medical or industrial endoscopy. The CMOS digital sensor with 250x250 pixels operates completely autonomous and provides 9 bit data over a bit serial LVDS data interface. The sensor requires only four connectors and can without external components drive up to 2 m cable. Optionally the sensor is available with a special small form factor lens directly assembled to the sensor and confectioned with a cable.

**Vision: Hall 6, Booth A11**

*Awaiba GmbH*
*Tel.: +49 911 21 52 178 0 · info@awaiba.com · www.awaiba.com*

FALCON
LED LIGHTING SYSTEMS FOR MACHINE VISION
Falcon LED Lighting Ltd. · Fasanweg 7 · 74254 Offenau
Web: www.falcon-led.de · Phone: 0(049) 7136 9686-0

## 10 MP Lenses from Kowa

Kowa will introduce a new line up of 2/3" Megapixel lenses especially designed for 10MP sensors. The complete range will be introduced at Vision 2009 and consists of six different models with focal length starting at 8 mm up to 50 mm. The advanced optical design of the new 10 MP lens series is supported by incorporating aspherical lens elements and special XD glass (eXtra low Distortion). All lenses are made of at least seven up to nine lens elements in order to achieve the exceptional requirements on resolution and contrast.

**Vision: Hall 6, Booth B54**

*Kowa Europe GmbH*
*Tel.: +49 211 179 354 29 · lens@kowaeurope.de · www.kowa.eu*

## Basler Presents Smallest GigE Camera

Basler Vision Technologies will present several new camera models at Vision 2009. Highlights will be the ground-breaking ace GigE camera series and new models in the aviator camera series. Basler launches a new series of ground-breaking industrial Gigabit Ethernet cameras, the ace series. These cameras are designed to meet the cost demands of analog users, while offering all of the technological advantages of a digital camera. The cameras provide an extremely small footprint, which will probably make them the smallest GigE cameras in their class. They have Power over Ethernet, high-performance features, and are very easy to integrate on the hardware and software side. The ace series will initially consist of four CCD camera models in monochrome and color with resolutions from VGA to two megapixels.

**Vision: Hall 4, Booth B59**

*Basler Vision Technologies · Tel.: +49 4102 463 258 · info@baslerweb.com · www.baslerweb.com*

VIEWPOINT

# From Academic to Businessman

*In a recent interview for our Visionaries series, we asked Savvas Chamberlain of Dalsa Corporation what it took for him to change from successful scientist to successful entrepreneur. There are some very enlightening business aspects in this history, so that we decided to publish this separately in our Viewpoint section.*

In the early 1970's I developed the Silicon Devices and Integrated Circuits laboratory at the University of Waterloo. The research of this laboratory was successful and known world-wide. In this laboratory in the 1970's along with my graduate students we pioneered the basic fundamental theory of charge transfer in small geometry CCD devices. By the beginning of the 1980's we had small geometry CCD devices operating at 20 times faster than the state of the art.

In the 1970's, while at the University of Waterloo and through its Waterloo Research Institute (WRI), I did consulting work for IBM at Yorktown Heights on the design of CCD image sensor chips. I also did consulting work for the design and development of MOSFET technology at Northern Telecom in Ottawa. By the beginning of the 1980's I was regarded as a very successful academic, with many publications and patents that I had authored or co-authored, and as a world-wide known researcher. I had graduated numerous graduate students and had brought a lot of research funds to the University of Waterloo.

Even though my consulting work was economically very lucrative, I wanted my CCD technology to be used in manufacturing and commercial products so that it would proliferate, generate highly skilled jobs and also create value added wealth. I did not want my research results to stay in research publications, in filing cabinets and in old scientific journals.

In early 1980's I went to IBM and made them an offer. Since they had interest internally in CCD image sensors and since they paid me to design these CCD image sensor chips, I could help them transfer my technology to them and in addition create a commercial CCD image sensor business. They said this is a great idea. They would immediately look at the business case. After doing a marketing and business case study they came back to me and said, this is not a $100 million per annum business therefore they were not interested, but if I did it as business they would continue giving me design work. My next stop was Northern Telecom and I talked to them. Immediately, they said, this was a great idea and would get the business development person to look at it. They came back and said since it was less than a $50 million per year business they were not interested. But if I did it by myself they would continue giving me business.

I gave all this information to the WRI guys. They said they could help me set up a start-up company. I said to them, "What do I know about business? I am a technical guy." The challenge, however, to me was very attractive. To see my research results used commercially and to proliferate was very tempting.

I used some of our family money, and with the help of WRI I got some venture capital money, all used to buy computers and laboratory equipment. I used also a patent that was jointly owned by me and WRI. I hired some of my own grad students and other University of Waterloo students. Brian Doody, Dalsa's present CEO, was a Masters student from the University of Waterloo at the time, and joined me in 1985. While I was trying to raise venture capital money, they were asking me about a five year business plan. At that time, I had no clue about such business plans. All I knew was that I already had customers. I had to continue producing higher performance CCD image sensors than anybody else, get more customers, and gradually move the CCDs to standard products. I did not know about "pro forma balance sheets" or "income statements;" all I knew was "conservation of cash." The cash coming in should be greater than the cash going out. Later on I learned at the Harvard OPM business course that this was called "cash flow." Also I believed and continue to believe in operating fairly with everybody. I feel that Dalsa is successful because I did not know that, (as was widely believed in the 1980's) you cannot succeed in semiconductors and electronics in Ontario, Canada.

**Dr. Savvas Chamberlain,**
Chairmanof the Board, Dalsa Corporation

# Controllable Time

## Image Processing Basics: Real-time

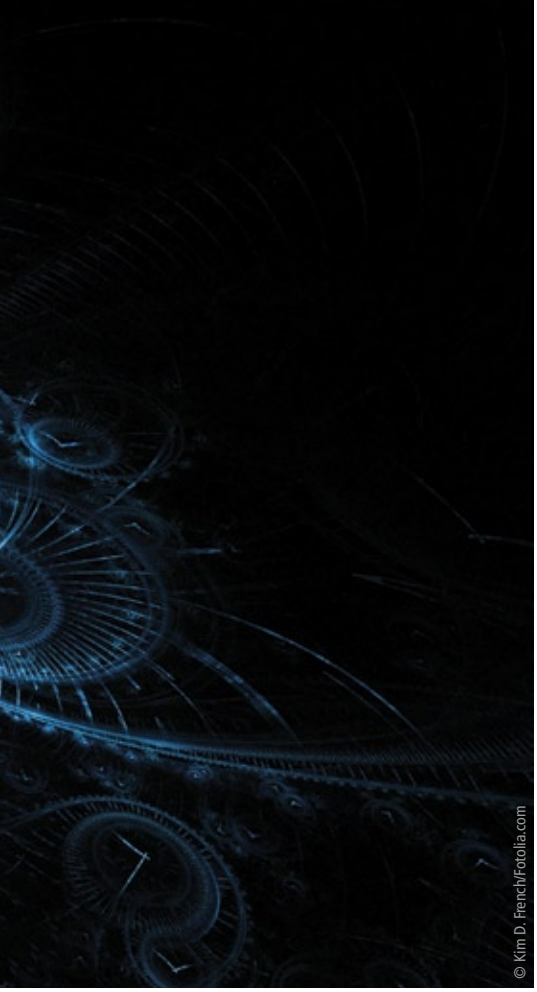
**"Real-time" seems to be a cool term in conversations about machine vision, but raising the question about the precise meaning may trigger some stimulating discussions. "Real-time systems" often are simply assumed to be "fast", whereas some people use the term for image processing at the frame-rate of a consumer video stream. This article tries to give a definition of real-time processing within the framework of the inspection of moving objects in a production line. The main features are the ability of a real-time system to react to asynchronous sensor signals at any time and to call back within a defined time interval.**

### Interrupt

Moving parts in a production line will appear in the field of view of the inspection system usually not at a constant rate, but rather at random, asynchronously to any other process. An image thus has to be captured on demand within a certain well defined maximum time interval whenever an object to be inspected appears in front of the camera. In order to meet this requirement, any system suitable for this task shall be able to permanently read out a sensor signal (a light-barrier, e.g.) or to react to an external signal by starting the image capture and by triggering other peripheral components, if necessary, such as a strobe unit. The information extracted by the image processing routine then usually has to be sent back to the process or will be used to directly initiate some action downstream like a robot, e.g., picking a certain part. The sensor signal may appear at any time. Such an asynchronous signal is usually called an "interrupt request". The system used for inspection has to be able to immediately react to such requests and halt any other process which might currently run on the system. Since not a single object must pass the inspection zone without an image being captured and processed, the system status has to be changed from "idle" to "alert" within a defined maximum time interval whenever an object triggers the light barrier. It is by no means trivial to ask for this specific requirement.

When an interrupt source in an operating system has a sufficiently high priority, the usual process running in the system will be interrupted, and the interrupt service routine will be called as soon as the request has been acknowledged by the system. The interrupt service routine will then take full control of the system. When this task is finished, the system status has to be restored, and the usual routine will resume control. The status of the process thus has to be stored before the interrupt service routine takes over. This is quite similar to a common function call, but with the notable difference that a function is called at a precisely defined line of code whereas an interrupt request will appear at random. During the interrupt service routine further interrupt requests may appear which may try to cut in on the current process. It is immediately clear that interrupt handling is by no means trivial.

An inspection system in machine vision thus will perform image capture and image processing within the interrupt service routine. Looking at the general structure, these tasks are rather the exception, the usual process being a more or less idle cycle. This may seem to be a quite uncommon view of the problem, but just lean back and think: the system usually just waits in a loop for the next part coming along like an eagle circling in the air, always carefully looking at the sensor which will detect an incoming object, triggering the interrupt service routine, which causes the system to swoop




down and catch an image. While being idle, the system may well perform some useful tasks such as checking the lighting system or compensating the noise floor. But the routine doing the crucial job will be the interrupt service routine, which will call back to the process with the result of the image processing operations. The system may be busy with image processing in a situation where a large number of parts come along with a small distance between two subsequent objects, but it may also be idle for several seconds when a huge gap appears.

The image processing in an inspection system for a continuous production line thus works on demand: the event "light barrier detects a part" triggers the image capture and the image processing routine. The event may appear at random, at any time, asynchronously to any other process in the system. The system thus has to be able to detect an interrupt request and to finish the interrupt service routine under all possible circumstances which may occur during the operation of the system.

## Keeping Pace

An interrupt request appears at random: the program may be working at a line of code somewhere in a function or at the beginning of the main procedure. Furthermore, since interrupt sources can only be scanned with a defined frequency, there will always remain an uncertainty about whether the incidence appeared at the beginning, at the end or sometime in between the time interval between the last and the last but one check on the interrupt flag. Managing interrupts is not trivial. During the interrupt service routine a further interrupt may be requested by the light barrier depending on how the signals at the sensor are evaluated. A large object travelling through may well trigger the interrupt again and again while blocking the light path. As an alternative, the light barrier might be programmed to trigger an interrupt when the object leaves the sensor rather than when it blocks the detector signal. Working with a system which is able to store all the interrupts coming in may also be a useful procedure. Even simple microcontrollers usually have several inputs to detect and latch interrupts.

Since an asynchronous hardware-interrupt always can only be detected with a remaining uncertainty in time, the position of the parts to be inspected will vary from image to image. Sensors and AD-converters also respond with a certain time lag and may show jitter. Image capture and usually a strobe-lighting must be triggered with a defined delay with regard to the sensor signal in order to catch the object precisely within the field of view of the camera. The call-back to the system also has to work in a well-defined manner on the time line to allow handling systems downstream to catch the proper object. The timeline of the events in reality thus must be mapped by the inspection routine in a sufficiently precise way to allow for tracking of the objects by all the mechanical and electrical components of the system in pace with the production cycle. The performance of the system according to this requirement is not only determined by the operating frequency of the processor, but also by the response times of the other hardware components.

## Real-time Processing

A real-time system must be able to detect an asynchronous interrupt request, to halt the actual task of the program and to finish the interrupt service routine, whatever the status of the system may be when the interrupt request appears. Mapping of the real timeline, however, is not yet ensured by these requirements. In addition, an upper limit for the reaction time of the whole system, including image capture, image processing and call-back to the process, must be accomplished. The standard configuration must be re-established after a certain, well-defined time interval beginning with the event which triggers the interrupt request, in our case an object entering or leaving the light-barrier. Systems, which work according to this requirement such that a maximum reaction time can be guaranteed under all possible circumstances in the process, are called predictable or deterministic. This is quite a tough requirement – it means that a guaranteed deadline always, without a single exception, will be met.

The reaction time is the sum of the following time intervals:

- The time interval needed to process and evaluate the sensor signals to raise an interrupt request. Time constants of analog electronic circuits, gates and memory access enter into this time budget.
- The time interval needed by the operating system to detect an interrupt request.
- The time interval needed by the operating system to call the interrupt service routine. Several operating systems give higher priority to other, internal processes and ignore external interrupt requests when system resources are scarce.
- The time interval needed to finish the image processing routine including image capture.

The sum of the first three time intervals usually is called the interrupt latency. During this time interval the interrupt is present in the system, but has to wait for being acknowledged and serviced. Data sheets and application notes usually quote this time interval. Unfortunately, the interrupt latency for a given system is not a constant, but is distributed somehow. Therefore, you may find so-called typical data, sometimes the maximum of the distribution will be given, and to see the full distribution, measured within a defined scenario, will be a quite rare experience. Unfortunately, only the full distribution is a reliable basis for a decision about whether the risk related to the appearance of reaction times longer than the desired time interval can be taken or not. The forth component, however, should not be underemphasized: proper or sloppy programming of the image processing routine may have a tremendous influence upon the real-time performance of your system. An image processing algorithm may need more or less time to run through depending upon the precise content of the image. Classification, e.g., may branch into several different loops with significantly different processing times. Such a behaviour may be caused by iterations, recursion or undersampling with subsequent refinement, to name only a few possibilities. The performance should thus be carefully evaluated for any possible status of the program whenever the real time behaviour of the system might be compromised by the program module. When programs become complex to a degree where systematic testing is no option, real-time performance can no longer be demonstrated in a strict sense. Critical items in this context are recursions, which may oc-

cur when finding the roots of a system of equations or in interpolation, and the permanent availability of sufficient memory. Needless to say, a function from an image processing library can never be systematically tested, in a strict sense, by a user without access to the source code.

### System Failure

A real-time system has to react under any possible external conditions within a defined maximum time interval, calling back with a deterministic result. Any reaction after the deadline will be regarded as system failure. As a consequence, the highest priority in the system will usually be given to the interrupt source, even higher than all priorities related to the internal processes of the operating system itself. Several well-established operating systems can not quote to be real-time systems according to this criterion, but need further modification by real-time extensions. That is a somewhat risky approach, since an operating system programmer aiming at office applications will probably not keep in mind the requirements of an extension which dares to tinker with his precious priorities. But never mind, there are derivatives based on common operation systems which have been developed precisely for real-time applications and are reported to work well. Peripheral components, however, may also compromise the real-time performance of a system. A classical strobe lamp, e.g., will fire at a rate basically determined by the time constant of the discharge capacitor. The real-time performance of the operating system may be first-rate in this scenario, but triggering the next strobe too early (because the next part already appears in the field of view) and without the capacitor fully charged, will usually not yield an acceptable image. In general, real-time performance is accomplished by systems which can capture an image on demand whenever an external signal triggers the process, react within a well-defined time interval by finishing the image processing routine, and call back to the process such that a deadline for the action to be taken can be guaranteed under any possible circumstances. Rather than throughput, availability of the processes and deterministic behaviour are the crucial issues in real-time applications. The acceptable maximum reaction time needed to keep pace with the production process, however, depends upon the requirements of the specific application. Since frame rates of 100 per second and transport velocities of 10 m/s are at the upper end of the requirement range for machine vision, reaction time intervals in the order of milliseconds usually will be sufficient to provide real-time performance, as long as parts come along one by one and with a specified minimum distance to each other. Real-time requirements for signal processing in airbags or ABS-brakes and in a lot of industrial control applications are much more demanding with reaction times in the microsecond range. With regard to real-time performance, image processing for inspection of moving parts in production lines can well be mastered with current technologies and will remain a safe field for a lot of years to come.

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Department of Optical Technology and Machine Vision
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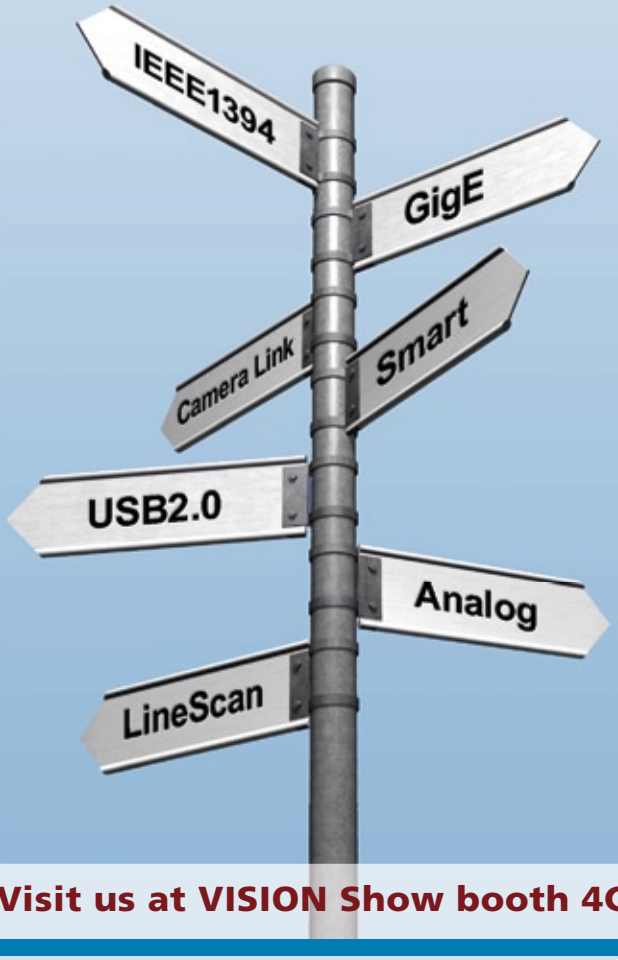

# Conquering the Tower of Babel

## Technology Guide Makes the Language of Experts Easier to Grasp

In his foreword to the "Technology Guide - Principles, Applications, Trends" editor and President of the Fraunhofer Gesellschaft, Prof. Dr. Hans-Jörg Bullinger, points out that today we are at the forefront of profound structural change as we move from the industrial towards a knowledge society. Driven by new technologies this change is characterized by a tendency to treat information as a product and knowledge as a strategic commodity. However, information can only become retainable knowledge if it is presented to us in such a way that it can be readily understood. This is where the Technology Guide seeks to present a solution to today's "Tower of Babel" dilemma that exists in communication between experts from different scientific fields. The book aims at making the language of experts easier to grasp so that experts from different disciplines can understand and inspire each other, and so that non-professionals, too, can join the discussion of technical issues.

The book is set up as a reference book that briefly and concisely describes the important current technologies. The vast material of 100 subjects has been grouped into 13 topic areas: four essentially cross-section technology categories (materials, electronics/photonics, information and communication technologies and biological technologies) and nine chapters covering application-oriented technologies such as mobility, energy, production or health. The result is an anthology with contributions from over 150 renowned technology experts from both small and large companies, research establishments, universities, associations and authorities.

The book is aimed at entrepreneurs, politicians, engineers, teachers, students and ultimately anyone with an interest in technology and intends to inspire us readers, to peak our curiosity as we browse through the pages. It makes a particularly exciting read if we let ourselves be guided to areas that lie beyond the knowledge horizon already familiar to us.

Each chapter is clearly structured into principles, applications, trends and prospects and manages to condense a lot of information on a complex topic in only a couple of pages each, which helps to grasp the concept of areas one is not an expert in. This is additionally supported by good illustrations and informative picture material. In separate boxes at the beginning and at the end of each chapter, respectively, are cross-references listed to other chapters in the book, and web links given for further information.

In addition to being an exciting read, the Technology Guide is also once again a proof of how deeply the future of technology is interwoven with imaging and machine vision. No less than nine out of the 13 chapters point out one or more of the various aspects of imaging as central to either state of the art or future prospects. The chapter Optical Technologies in the Electronics and Photonics section explains the concepts of optical tweezers, rapid prototyping, Laser Doppler vibrometers and holography. In the Optics and Information Technology chapter the digital camera, optical fibres and plasma and liquid crystal displays are highlighted. For Sensor Systems the author of the respective chapter sees the future trends in sensor fusion and sensor networks. The Measuring Technologies chapter refers to the principles of laser light section technology, laser spectroscopy and LIDAR. Image Evaluation and Interpretation is a chapter in the Information and Communication section. The future trends pointed out here are the increase of complex mathematical methods due to ever-increasing computing power, adaptiveness of systems and learning strategies, real and virtual (by motion) camera arrays to accumulate information, the usage of image series and methods of automatic image (content) retrieval. The Health and Nutrition section highlights imaging technologies in the chapters on Medical Imaging, Medical and Information Technology and Assistive Technologies. In the Digital Infotainment section of the book, imaging plays a major role in Ambient Intelligence, Virtual and Augmented Reality and Human-computer Cooperation. As can be already seen today imaging and machine vision are intrinsic as well in Mobility and Transport (driver assistance, traffic information systems), Environment and Nature (environmental monitoring, agricultural engineering), Lifestyle and Leisure (sports technologies), Production and Enterprises (automation, robotics, digital production, logistics) and last but not least also in Security and Safety (detection, surveillance).

The fact that almost every section of the book provides a link to an area of interest for a reader from the imaging and machine vision field is but merely the cherry on the cake. The Technology Guide is certainly a book that you do not want to miss in your library.

Technology Guide,
Hans-Jörg Bullinger (Ed.), Springer,
ISBN 978–3-540–88545–0

Readers' Corner

ONLINE

**We´ve researched the Web for you and found this:**

**www.freemind.softonic.de**

■ This freeware documents ideas, thoughts and approaches to solutions graphically in the form of mind maps. Results of creative thought processes are sorted according to certain pre-defined criteria. Intuitive user navigation, immediate benefit.

**www.doodle.com**

■ Neat tool for the Internet-based scheduling of appointments and meetings with larger groups of participants.

**http://network.inspect-online.com**

■ This is where the industry meets, networks and exchanges information. Social network especially addressing all stakeholders in machine vision, imaging, and optical metrology.

**www.dopplr.com**

■ Travel planner with useful information on all kinds of (business) destinations. Main goal is, however, to inform your own network of your future whereabouts. Meet friends while travelling.

**www.airforce.com**

■ The website of the American Air Force was recently re-launched and is one of the technically most advanced pages you can find today on the Internet. Super graphics, a wealth of information and a whole range of cool gimmicks like, e.g., the look through the eyes of special ops: normal, thermal vision, night vision

**www.eyeplorer.com**

■ Eyeplorer refers to itself as "visual knowledge engine". As opposed to your standard search engine, this software does not only find links in the web, but directly retrieves content related to any chosen keyword and points out relationships among this data. The search area most certainly needs further enhancement but the result is already amazing. The software can be switched to search for English language content although the user navigation is in German. There is an English introductory video provided.

**http://www.youtube.com/watch?v=EjAoBKagWQA**

■ 6 axis robot creates I, Robot´s Sonny. Robots radiating erotism at the sounds of Björk. You will look at your production robot through different eyes from now on.

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

# Calendar

| DATE | TOPIC · INFO |
|---|---|
| **03.–05.11.2009**<br>Stuttgart, Germany | **Vision 2009**<br>Leading trade show for machine vision and identification technologies<br>www.vision-messe.de |
| **10.–13.11.2009**<br>Munich, Germany | **productronica 2009**<br>Leading international trade fair for innovative electronics production<br>http://productronica.com |
| **12.11.2009**<br>Frankfurt, Germany | **4th International Symposium on Emerging and Industrial DLP Applications**<br>Annual Symposium focusing on technical and application related aspects of industrial DLP systems<br>www.dlp-symposium.com |
| **24.–26.11.2009**<br>Nuremberg, Germany | **SPS/IPC/Drives 2009**<br>Exhibition for electric automation technology<br>www.mesago.de/sps |
| **25.–27.11.2009**<br>Milan, Italy | **Vision World 2009**<br>First Mediterranean exhibition entirely dedicated to machine vision and identification technologies<br>www.photonicaexpo.eu |
| **02.–04.12.2009**<br>Yokohama, Japan | **'09 ITE**<br>International technical exhibition on image technology and equipment<br>www.adcom-media.co.jp/ite/eng |
| **02.–05.12.2009**<br>Frankfurt, Germany | **Euromold 2009**<br>World fair for mold making/tooling, design and application development<br>www.demat.biz/euromold/english |
| **20.–22.01.2010**<br>Orlando, FL, USA | **AIA**<br>Business Conference of the American Imaging Association<br>www.machinevisiononline.org |
| **23.–28.01.2010**<br>San Francisco, CA, USA | **Photonics West 2010**<br>The latest advancements in light-driven research and technologies<br>http://spie.org |
| **16.–17.04.2010**<br>Istanbul, Turkey | **EMVA**<br>Annual Business Vonference of the European Machine Vision Association<br>www.emva.org |
| **19.–22.04.2010**<br>Moscow, Russia | **PHOTONICA**<br>Leading exhibition event of the Russian laser and optical industry<br>www.photonica-expo.com |

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# INSPECT

## Vision



### MORE THAN JUST CAMERAS – BAUMER OFFERS THE COMPLETE SOLUTION FOR GIGE VISION

Baumer, the specialist for GigE cameras, is going one step further with its range of products and provides its customers with all the components necessary for a GigE Vision-compatible complete solution. As the only source, Baumer provides specially developed industrial GigE network components making it simple to integrate the cameras into the network. At the same time, Baumer helps save installation costs with an innovative single-cable solution thanks to Power over Ethernet (PoE) and the newly developed Trigger Device to control basic processes. This all makes the changeover to GigE technology as simple and effective as never before.

Baumer

www.baumer.com

More on Page 42

# Package Deal

## More than Just Cameras – the Complete Solution for GigE Vision


**With the introduction of GigE as a standard interface for machine vision, numerous new applications have been implemented that only became possible thanks to the benefits of long cable lengths and the high data rate. System set-up with several cameras was simplified greatly by the network structure. Besides enhancing safety and reliability this primarily increased the flexibility of the systems. The introduction of Power over Ethernet (PoE) also made it possible to implement a single-cable solution that reduces installation and maintenance costs.**

With the new Trigger Device of the GigE Power Series Baumer goes one step further and offers a GigE complete solution to control simple industrial applications. In some cases this solution eliminates the need for an additional PLC. All necessary network components for a complete solution compliant with GigE Vision are bundled to a package deal.

### Process Integration for Experts

The new Trigger Device forms the bridge between the vision system and the process environment. It extends the proven camera technology with system interfaces enabling individual integration into the process. The basic function of the Trigger Device encompasses real-time triggering of cameras over the Gigabit Ethernet Network. The correct trigger points are calculated from process parameters, such as the switching functions of light barriers or the speed information from encoders, and image acquisition from one single or an assigned group of cameras is triggered by means of the GigE Vision-compliant Action commands. Comprehensive studies have shown that the transmission times in the GigE network are negligible. By planning the network with foresight, the jitter can be kept to less than 5 µs. To achieve extremely short latency times as well, all functions were implemented in hardware in the Trigger Device. However, the real-time capability can only be fully exploited if the reception of the Action command is also implemented in hardware as it is the case for all Baumer cameras. In conjunction with the Power over Ethernet functionality of the Baumer cameras, true single-cable solutions can be created using this function.

Numerous additional intelligent and valuable functions help the user to simplify the structure of the vision system. The Trigger Device is designed to operate a maximum of four independent systems, each with two inputs and two outputs. Typically, the inputs are used to connect light barriers for triggering image acquisition and encoders for delaying the trigger point as a function of speed. The trigger point can be set to the rising or falling edges or even to the center of the pulse. Constant propagation times can also be offset using additional time-dependent delays. The two outputs can be individually adapted to the desired switching function by setting travel-dependent and time-dependent delays, pulse width, polarity, etc. Typically, the outputs are used for controlling the illumination system during image acquisition and for controlling a product gate that discharges a specific product from the process depending on the result of the image processing operation. With this ingenious function, an additional PLC is not needed in simple applications. Of course, the functions of

### Trigger Device Data

Trigger Device with 2 or 5 ports

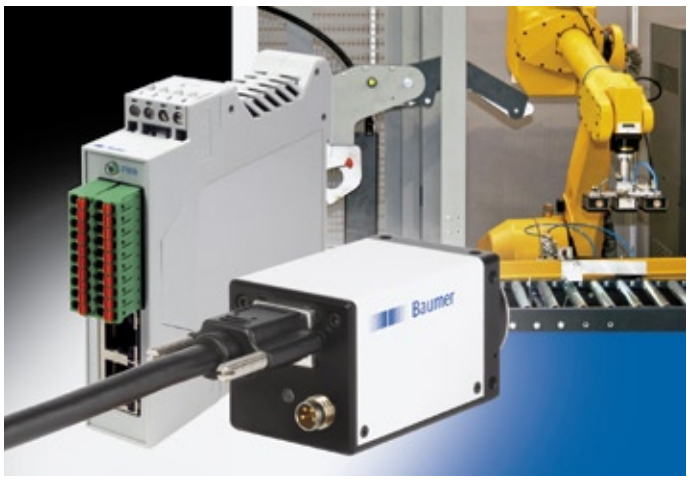
Power supply 24 to 48V (nominal)

4 Inputs/4 clock inputs/8 outputs,
PLC conform (max. 100 mA per output)

Power supply for external sensors 24/48V

Temperature range 5–55 °C

DIN rail mounting




◀ Innovative trigger device for active pro-cess control

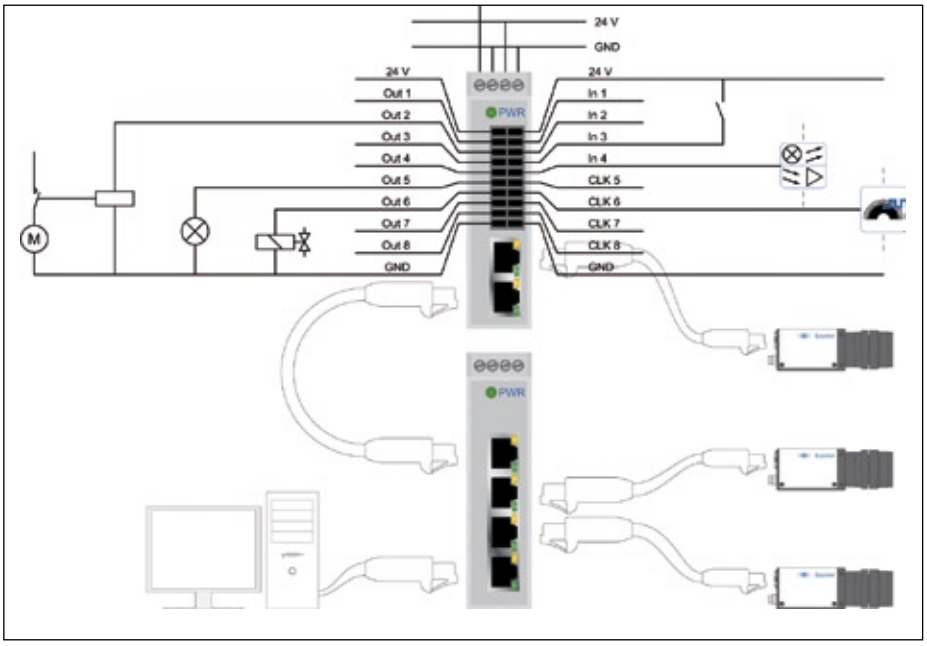

Network components of the GigE Power series ▶

the total of eight inputs and eight outputs can also be used or combined differently. Overall, they can be flexibly adapted to the widest range of applications. It is also possible to sample or set the values via a central PC.

## The Trigger Device as a Network Component

Typically, the Trigger Device is installed on site in the process to minimize the cabling expenditure between sensors, actuators and the components of the vision system. However, it can also be configured centrally in the control cabinet as a real-time gateway between an existing PLC and the distributed vision system to exchange control commands without the PC being used at all. There are virtually no limits to the possible configurations. To be able to react flexibly to the most varied applications, the Trigger Device was designed as a GigE component for GigE Vision-compliant networks. It can operate easily with all components that comply with Standard Rel. 1.1 and really shines with cameras of the Baumer TX Series. A switch is necessary in the network for real-time distribution of the information between the camera(s), PC and the Trigger Device. For this reason, the Trigger Device was designed as a complement to the existing network components of the GigE Power Series from Baumer. Together with Baumer PoE cameras, true single-cable solutions can be created. To supplement existing networks or central mounting in the control cabinet, a stand-alone version was created with an integrated 3-port switch where two ports are PoE-ready. Both versions are designed for a voltage range of 24 V to 48 V without a switchover, just like the other components of the GigE Power Series. Mounting uses one DIN rail. The functions of the Trigger Device are easily configured over the network. A convenient, innovative tool with an intuitive graphical user interface makes complex programming easy and pre-


The trigger device is assembled on DIN rails




Schematic representation of the network integration

vents the user from losing perspective. Of course, all functions can also be controlled via the SDK, the generic Baumer GAPI interface, in customer-specific applications.

## The Network under Control

The network components of the Baumer GigE Power Series were created with the goal of providing the best possible integration support for Baumer GigE cameras in industrial applications. In this respect, besides the safety and reliability of the vision systems, flexibility and simple and robust operation were very important. One particular focus was the support of cameras with Power over Ethernet, a technology with only a few suitable accessory components on the market.

With PoE technology, the power necessary for operating the camera is transmitted at the same time as the image data at 1,000 Mbit/s over a standard Ethernet cable. The Baumer PoE cameras cover the range from VGA to 5 megapixels using high-quality CCD sensors. For the type of housing, a choice can be made between the known small and compact standard version and the completely encapsulated IP 67 type of housing designed for harsh environments.

The Baumer GigE Power Series currently includes two unmanaged PoE-ready GigE Power Switches of different expansion stages and one GigE Power Injector.

The basic version of the switches contains four 1000base-T ports and, in addition to providing the PoE supply, offers the potential of transmitting jumbo frames with up to 10.2 kb/s at a maximum data rate of 1,000 Mbit/s. The user can revert to the 6-port version for more complex requirements. This version is equipped with one additional 1000base-T port and one SFP port. The SFP port can be equipped with an additional Cu or a fiber optic module for environments where EMC is critical. If the switch function is not necessary, the GigE Power Injector developed by Baumer can be used to supply power to two PoE cameras. This guarantees a transparent data throughput without restrictions with respect to frame length, etc. The PoE switches and cameras can be operated using both 48 V and 24 V as provided in most industrial environments.

## Perfectly Tuned

With the GigE Power Concept, Baumer is the first manufacturer to offer a complete solution for demanding machine vision systems consisting of cameras, network components and a Trigger Device that can be used to control simple processes within the system. The consistent development of GigE Vision-compatible products provides a perfectly tuned product range for a variety of applications.

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# Smart, Smooth, Strong

## Next Generation Smart Camera for Factory Automation

**Over the last decade, the vision industry has produced a variety of "all in one" smart camera solutions to address a range of optical inspection needs, from elegant pass/fail vision sensors to compact vision systems. This evolution of integration and software simplification has made it easier for manufacturers to install and maintain machine vision on the factory floor. As a result, embedded vision solutions have become an integral and often essential ingredient for factory automation.**

With growing adoption of smart cameras in factories comes even greater expectation for product capabilities and ease of integration. To meet this, Dalsa has introduced a next generation smart camera with all the capabilities of a sophisticated vision system. Simply named BOA, this highly integrated system offers manufacturers and vision integrators an advanced, yet cost-effective solution that is quick to set up, ready-to-deploy and easy to maintain.

### Small, Rugged Form Factor

The small mechanical footprint and 360° direct mount capability of the smart camera make it ideal for tight-fit applications. When fitted with an optional screw-on lens cover, BOA operates comfortably in harsh wash down factory environments without the need for additional protective housing. The small form factor, easy mounting, and rugged housing allow for easy integration into existing production lines, machinery or moving equipment.

### Multiple Processors

BOA combines an on-board Digital Signal Processor (DSP) with other processing elements to offer superior performance at very low power consumption. These multiple engines allow the partitioning of processing tasks such as algorithm optimization via DSP, application management via CPU and sensor functionality via FPGA. In addition, these flexible processing options offer opportunities for more complex, custom development that is typically required by machine builders.

### Flexible Cabling

The new product supports standard low-cost M12 style cord sets that are readily available in factories. 8 pole connectors are provided for Ethernet and I/O, while a 5 pole configuration is used for external LED lamp control and RS-232 communication. Integrated lamp control simplifies wiring to and from the point of inspection. To further simplify cabling and reduce cost of deployment, Dalsa has implemented passive Power over Ethernet for applications that demand a single cable solution, as is often the case for robotic handlers. In this configuration, the camera is controlled exclusively over Ethernet.

### Versatile Application Software

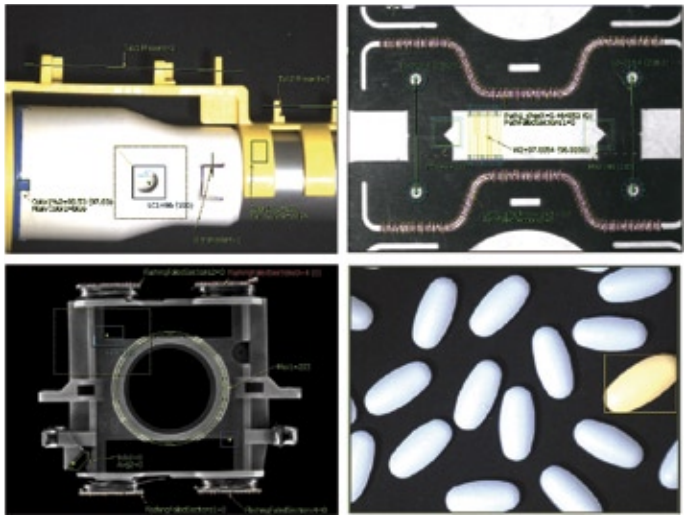
BOA comes bundled with Dalsa's intuitive and versatile iNspect application software. The development interface and runtime engine is embedded within the camera and accessed through a standard internet web browser. This unique fea-

ture eliminates any possibility of version control problems between the set up PC and the vision system.

This flexible application interface allows users to deploy and maintain vision solutions with little or no prior experience. iNspect offers easy-to-apply tools and capabilities to satisfy a diverse range of manufacturing and factory automation needs.

## Development Environment

BOA vision systems are configured and monitored remotely using an Ethernet connection to a PC or factory network. An inspection is set up using a web browser portal into the resident iNspect application. The dedicated web server provides a simple user interface for configuration and access to the iNspect GUI. When the user clicks on the iNspect link, the full application is launched from BOA on the connected PC. Once the application is configured, the PC can be disconnected and the smart camera will run autonomously.



The BOA can be used in a multitude of applications

The iNspect software has been carefully designed to offer a balance of simplicity and flexibility for all levels of vision expertise:

- Quick four-step set up,
- touch screen style design,
- full complement of vision tools,
- direct PLC interfacing built-in,
- language support,
- scripting,
- history logging,
- password control and user data logging,
- runtime editing,
- operator customization.

An iNspect application can be quickly set up in four steps:

**1. Acquire an image of the model**

Simple slider controls allow users to adjust sensor exposure and image position referenced to an external trigger source, such as an electronic photo-eye. A reference template image can then be ac-


**The BOA comes bundled with Dalsa's intuitive and versatile iNspect application software**


**Dalsa's iNspect software is ideal for both first time and experienced vision users alike**

quired on which the inspection will be developed.

### 2. Apply Tools

Select and apply tools on the model image. iNspect provides an extensive suite of tools and smart features that allow users to develop complex vision applications with little or no machine vision background.

### 3. Integrate

Set up communications between BOA and complementary devices within the inspection environment or factory enterprise. iNspect supports standard protocols, such as Modbus and Ethernet/IP. A scripting tool offers users greater control and integration flexibility. The script tool provides a suite of predefined functions and supports user defined inline and/or background scripts.

### 4. Run

Start the inspection. iNspect offers history logging and runtime editing features to assist with initial development debug and runtime control. When satisfied, the solution can be stored on the smart camera and run with or without the network connection. BOA has plenty of on board storage memory to support hundreds of solution files that can be selected via network commands at runtime.

Included with iNspect is a fully functional emulator that allows users to develop or debug applications offline. Runtime images can be saved directly to the offline PC using BOA's Ethernet interface. The emulator maximizes machine up time during program development and simplifies support.

## Applications

BOA offers a versatile vision solution that can be readily applied across a diverse range of applications and industries. The iNspect software enables users of all experience levels to integrate automated inspection into their manufacturing processes. Typical inspection tasks include:

- Positioning: Locate parts or features for alignment or robotic guidance.
- Identification: Decode printed symbols or read printed characters for part verification or traceability.
- Measurement: Check precision dimensional accuracy and geometric tolerances.
- Verification: Verify features, parts, assemblies or contents of packaged goods.
- Flaw Detection: Detect flaws, such as contamination, scratches , cracks or discoloration.

The BOA vision system is currently offered with a 640 x 480 monochrome CCD sensor. Dalsa plans to follow with color and high resolution versions in the coming months.

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# Making Science Fiction Fact

## Futuristic Computer Interaction through Stereoscopic Vision

The processing power of computers may have improved by many orders of magnitude since the computer was first invented but the way in which we interact with such devices has changed very little over the same time period. Vision systems that interpret information from twin cameras are beginning to change this, with the creation of futuristic interfaces that go beyond those dreamt of in science fiction.

If you ask someone on the street how you can interact with a computer they will most likely come back with three methods – keyboard, mouse, touch screen. And this means that very little has changed in nearly four decades. The mouse and keyboard have been used as the de facto controller since the Xerox Alto was developed in 1972. And even the touch screen, which is now becoming ubiquitous in smart phones and tablet PCs, has been around since the early 1970s – Elo TouchSystems announcing the first touch screen in 1974.

These touch control systems proved popular in heavy industry and in areas, such as room automation, where keyboard and mouse systems do not allow a satisfactory, intuitive, rapid, or accurate interaction by the user with the display's content.

But, stereoscopic vision systems are enabling new ways of communicating with the digital world. These new systems are more intuitive to use and, in many ways, reminiscent of science fiction films such as the 2002 Tom Cruise movie Minority Report.

### Beyond Sci Fi

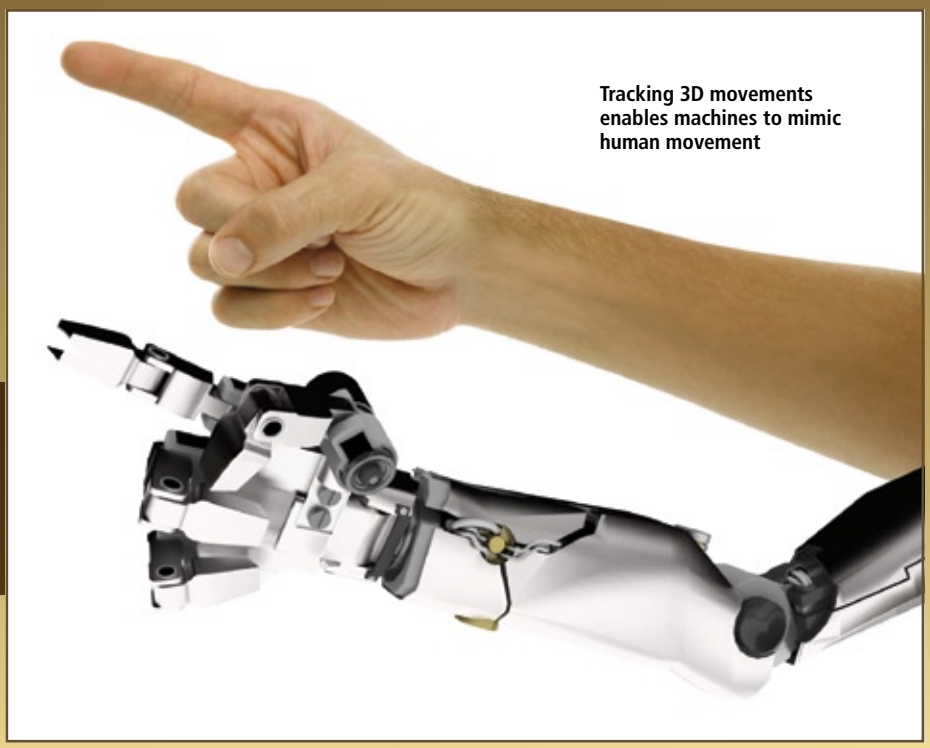
Minority Report envisioned a computer interface that was capable of tracking hand and finger movements. In the film, gestures, from pointing to grabbing and from opening to waving, were interpreted to control and manipulate data on the screen. But, the accuracy, precision and increasing bandwidth of today's cutting edge vision cameras enables more than just finger control.

Of particular note is an interface created in Switzerland, through a collaboration between Atracsys and Sony Image Sensing Solutions. The result is called Interactive Communication Unit, or ICU for short. At the heart of ICU are two high-specification IEEE1394.b cameras that track a user's precise three-dimensional movements; and even their emotions. The cameras are linked to a computer which, in turn, instantly updates the content displayed on-screen.

ICU has utilised two Sony XCD-V60 cameras which are linked to a standard

Finger control: Stereoscopic vision cameras enable PC control via hand gestures

(Photo: Suprijono Suharjoto)



Tracking 3D movements enables machines to mimic human movement

CPU. It is understood that the cameras will be upgraded to the XCD-SX90, which benefits from 1/3 type PS IT sensors.

The subtle characteristics that ICU is able to detect makes the vision system ideal for applications such as marketing. A users age and sex can be determined and moods including happiness, anger, sadness and surprise can be interpreted. This is done by tracking, for example, the upturn of the mouth or the widening of the eyes both of which accompany a smile. Using two cameras allow these to be tracked through three dimensions and enables a computer interface that more deeply immerses a user within an application, be it for industrial, marketing or gaming purposes.

## Tracking Options

Getting rid of the mouse: By using a stereoscopy vision system it is possible to precisely determine where a person is pointing or, indeed, where a person's focus lies. This enables to move a mouse pointer with the finger or gaze and a secondary movement, such as a smile or nod, is used to simulate a 'click'.

For marketing applications, which the technology is currently being used for, this gives access to web-based content to deliver additional information on a product or service. For example, a person staring at a watch or gadget in a shop window could gain access to reviews or the official website to find additional, relevant content.

And, similar to a touch screen's multi-touch capability, vision systems are also able to interpret multiple gestures; one such example is circular menus, whereby the cursor is piloted by moving the head left/right or up/down.

Positioning correctly: Be it a window display or an industrial application, people are rarely in the optimal position to view and interact with content. Stereo vision enables the computer to calculate precisely where a user is. Taking this information into account, it is possible to adjust the data displayed using electronic 3D rendering effects to best meet the user's needs.

Mood control: By detecting the smallest of movements in a person's face, ICU can be taught how to interpret a person's response. As marketing applications is one of the key sectors predicted by Atracsys to adopt the technology, this sensitivity of motion detection will prove to be vital. Content can be adjusted to not only tailor to a demographic scope, but to precisely tailor to a person's moods.

Gaming applications: By moving the entire body, a user can simply and successfully interact within gaming content. Simple algorithms running on the CPU and tailored to each application would allow avatars to mimic real life activity. For example, a classic such as the space invader game of the 1970s could be controlled by a player's left and right movements to steer the spacecraft accordingly. This interactive capability has important consequences also beyond games and marketing applications. In industrial applications, for example, users would be able to control robot arms remotely using simple hand or arm movements.

## Future Applications

Improving computer interfaces to make them more intuitive and involving is essential. Beyond commercial applications, interfaces based on vision systems could also play a strong role in the medical world. A potential application of this is in the operating theatre. Surgeons would be able to access electronic data without being forced to touch a computer mouse or keyboard – and therefore maintaining sterile conditions.

Stereoscopic vision systems have enabled the biggest change in computer interactivity since the mouse and touch screen were developed in the early 1970s. The technology behind ICU can be used for virtually any purpose and can be adapted to the needs of each application. The limitations come primarily from the capacity to imagine interesting content and from space restrictions that will complicate features such as multi-user experiences.

The film Minority Report brought the concept to the world's attention and it has taken less than seven years to develop the technology from this point and make science fiction real.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# Take on Color

## 1-Chip CCD Cameras Compute Colors from Luminance Values

**What a colorful world we live in… Well, not really. CCD and CMOS chips are only able to capture luminance values, thus making them color-bind. How is then possible for us to watch television in color? The answer to this contradiction is simple: Television cameras use three chips. Each is fitted with a filter – one per color red, green and blue.**

We expect television cameras to offer a high image quality but also to have a high price. If, however, the camera has to be small and/or available at a low price, it is not possible to use three chips. How is it therefore possible to obtain colors from one single color-blind chip? The following sections offer an answer to the question. To make things simple, we are going to concentrate on CCD cameras in the following. CMOS cameras process colors in a very similar manner.

### Why Color-blind?

The pixel information on a CCD chip is comparable to a bin in which, during the exposure time, free electrons are collected (fig. 1). According to the photoelectric effect these free electrons are created by photons encountering the bin. At the end of the exposure time, the electrons drain off via a resistor, thus creating a voltage. An A/D converter transforms this voltage into a digital gray level. This value is „gray“ as the photon‘s wavelength, and thus the color, is not transferred to the electron. The camera simply evaluates the number of electrons. It is proportional to the number of collected photons and thus the intensity of light.

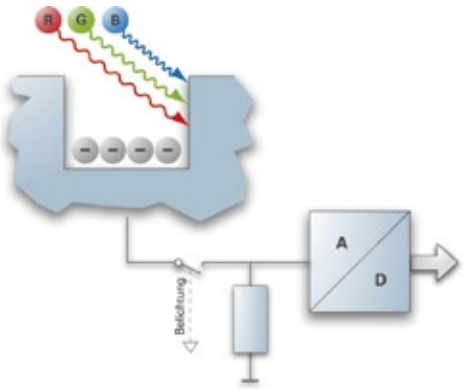


**Fig. 1: Photons encounter a pixel, creating electrons (photoelectric effect)**

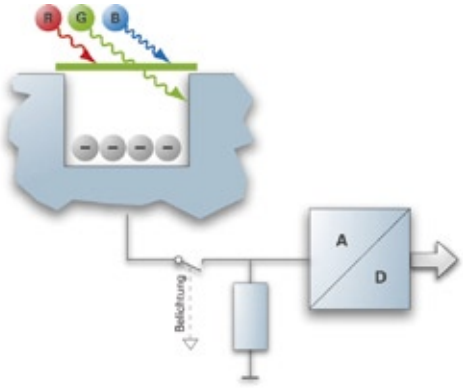


**Fig. 2: A filter in front of the pixel makes sure that it only sees green**

### Now Color Gets into the Game

By placing a green filter in front of the pixel (fig. 2) only green light creates electrons. At the end of the exposure time the electrons drain off via the resistor and yield, by means of the A/D converter, a digital signal – a gray level. The value itself only carries information about the intensity of light, not its color. However, it needs to ensure that this gray level is considered as green. Therefore, the information “gray level is originated by green light” has to be added.

### Elegantly Solved

The process for green is also true for red and blue. At first glance, this additional color information demands that two more bits be stored. While working for Kodak in 1976, Bryce E. Bayer however had the idea to equip every second pixel of a CCD chip with a green filter and distribute blue and red filters equally to the remaining pixels (fig. 3). Because of this mosaic-like arrange-

ment, a Bayer filter is also referred to as a mosaic filter. Consequently, as the mosaic has a regular structure, the additional information for the color is carried by the pixel's coordinates.

## Computing the Color

Each pixel is now allocated to a color value. However, each pixel should ideally provide the three colors which would be only possible with a real three CCD chip. That's why the color information from the neighbor pixels is copied: The red pixel misses the blue and green values, which are located in the direct neighborhood (fig. 3). The main advantage of this method is simply speed: The quality is sufficient for moving scenes. For static scenes, however, the result is too grainy. Better results are achieved by using the average of neighboring values. This method requires more computing power and the averaging leads to smeared edges. Therefore, algorithms have been developed that do not simply average neighboring pixels, regardless of the consequences, they notice the presence of an edge and behave more delicately which again raises computing efforts.

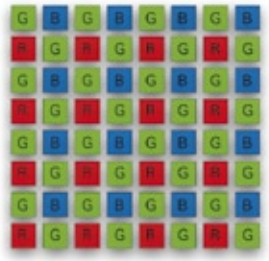

Fig. 3: In the case of one color CCD chip, the pixels are equipped with filters, which are arranged as a mosaic

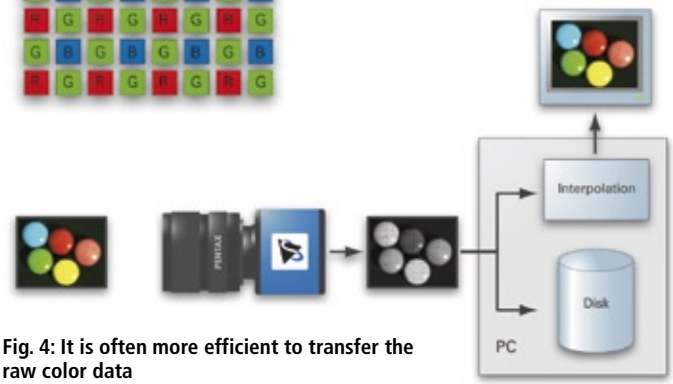


Fig. 4: It is often more efficient to transfer the raw color data

## Only for Looks

By interpolating the colors users don't get more information: Existing information is simply presented in a more common form. To get this, the transfer rate increases considerably and consistently, the camera's frame rate drops, while the disk space required to store the additional data increases, and this for empty information. From the measurement point of view the sensor (camera) manipulates even the captured signal (image) to make it look „nicer".

Figure 4 shows a way out of this problem: The camera outputs the raw color data. As a result, both the transmission and the archiving of the images become more efficient. Furthermore, those who work in a measurement context are able to work with the original data. The color interpolation is only activated when the images need to be visualized.

In some cases, it may also be beneficial to do the color interpolation directly within the camera. Consequently, modern industrial cameras can be toggled by software between raw data and interpolation.

## More Information

If you would like to learn more, you can download a number of white papers from The Imaging Source's web site at www.theimagingsource.com. Additionally, you can try out the free „Bayer Demonstrator" tool for Windows, which, based on a number of simple images, illustrates how color interpolation works.

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# Speed Booster

## Networking Technology Doubles the Speed of GigE Interfaces

**Allied Vision Technologies (AVT)'s new range of GigE cameras, the Prosilica GX-Series, combines high-speed and high-resolution. Running at 240 MB/s data rate, the GX-Series are the fastest GigE Vision compliant cameras in the world. – How does that work?**

To achieve a rate of 240 MB/s the GX-Series use Link aggregation (LAG), or IEEE 802.3ad, a networking technology that uses multiple Ethernet ports in parallel to increase the link speed beyond the limits of any one single port. Link aggregation allows the transfer of much more data than one single port can deliver. The LAG technology has been used in IT networking for years and is supported by a wide range of standard Ethernet hardware (switches, interface cards, etc.). For any application's point of view, link aggregation offers an inexpensive way to set up a high speed network while allowing the network speed to grow incrementally as demand increases without having to replace hardware or add more cabling.

In the case of the GX-Series, the host computer sees the camera as though there is only one GigE cable connected, even though there may be two. When the camera is connected by two cables to the host computer, the host computer only sees it as one connection at twice the normal speed (240 MB/s). The GX-Series can also work at half the speed (120 MB/s) using a single cable. The GX-Series operate with standard CAT-5e Ethernet cables.

Back of a Prosilica GX-Series camera showing its two Gigabit Ethernet ports


Prosilica GX-Series: compact GigE cameras – 240 MB/s

## Unique Features

The GX-Series introduces two new features: video auto-iris control and three-axis motorized lens control. The three-axis motorized lens feature is integrated into the GX camera hardware to control lens focus, iris and zoom directly and remotely via the AVT/Prosilica GigE Software Development Kit without the use of an external control box.

The GX-Series also include all the features of the GE-Series cameras including external trigger and sync I/O, RS-232 peripheral port, advanced binning modes, offset controls, non-volatile configuration memory, event recorder capability, pre-trigger recording, programmable strobe functions, multicasting, configurable IP addresses, 128 MB resend/image buffer, auto-exposure, auto-gain and auto-white balance controls.

## Camera Family

Four models are currently available, the fast Megapixel GX1050 (120fps), the 2 Megapixel 2/3″ optical format GX1660 (60fps), the 2 Megapixel HD resolution GX1910 (60fps) and the 8 Megapixel GX3300 (15 fps). A 4 Megapixel model will be released in 2010.

All GX-Series models feature high performance progressive scan Kodak KAI CCD sensors. These sensors (KAI-01050, KAI-02050, KAI-02150 and KAI-08050) offer excellent image quality, high sensitivity, electronic shutter, low noise, anti-blooming, improved smear performance, high quantum efficiency and fast frame rates. The 14 bit A-D provides high quality images to meet the most demanding applications such as machine vision, high-speed industrial inspection, avionics, traffic monitoring, license plate reading (ANPR), public security and intelligent transportation systems (ITS).

Available in either monochrome or color models, the GX-Series are fitted with a C-mount with adjustable back-focus and provide uncompressed digital output in Mono8, Mono16, Bayer8, Bayer16, RGB24, YUV411, YUV422, YUV444, BGR24, RGBA24 and BGRA24 image formats.

All GX-Series models offer full compatibility with the AVT/Prosilica GigE Software Development Kit.

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# Vision System Modeling

## Vision System Design Using CAD Software

**Engineering design software tools are well established in mechanical, optical or electrical engineering and many new products are first designed and optimized with such software packages. Vision system design and integration should be no exception.**

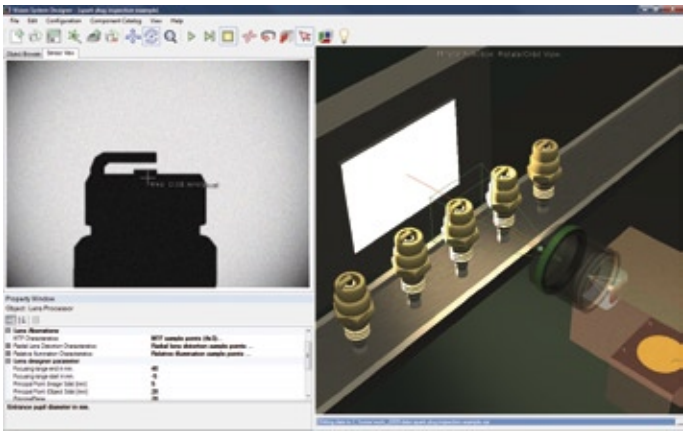

Application engineering is a major cost factor and the ability to simulate, evaluate and optimize enables engineers to build better, more complex and more refined systems in a shorter amount of time. Just like other CAD software packages, vision system CAD software should provide an interactive environment where a user can describe and model relevant system and component properties. Functions specific for vision systems can then assist with performance analysis, compliance verification, optimization and simulation.

### Vision System Modeling

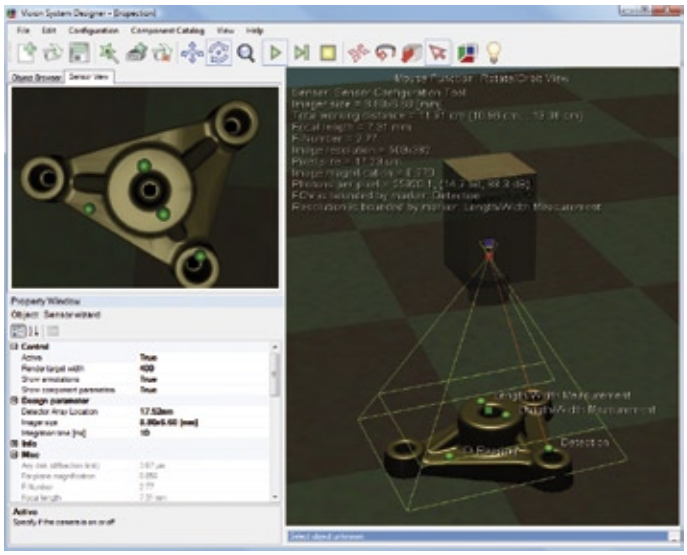
A new software product called VisionSystemDesigner 1.0 has these features. Modeling a vision system with this software starts by importing 3D geometric CAD models of the application context, the target machine and the product to be inspected. The user can then place a camera model in the virtual machine. A camera model describes the camera geometry, interfaces and internal camera characteristics related to the image formation. When a lens model is connected to the camera the combined system then provides simulated images as seen by the sensor. The next step includes motion or lighting. By dragging configured parts from a database catalog into the 3D-workspace or by modeling lenses, cameras, and lighting individually, developers are able to compose and simulate virtual vision systems corresponding to the anticipated installation on a target machine. A vision system modeled in this way is documented in an electronic format. Based on this description the VisionSystemDesigner software can calculate various system performance characteristics. For example, in a detection or measurement application the software calculates or visualizes image noise, lighting levels, image resolution, field and depth of view, the impact of perspective and lens distortions, variations due to displacements, existing motion blur or possible specular reflections. Such performance characteristics are helpful for integrators who need an easier and more systematic way to evaluate different configurations with respect to their feasibility and compliance with requirements.

### Component Specification

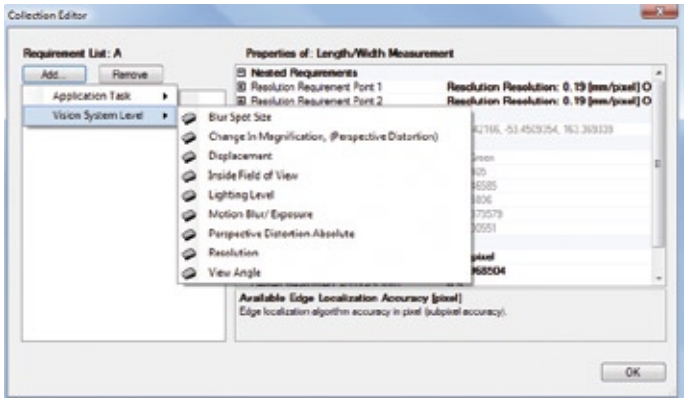
The VisionSystemDesiger software is also useful for specifying requirements and selecting appropriate components. Planning a machine vision system starts with understanding and defining of application requirements. Requirements can be specified in the VisionSystemDesiger software by annotating the 3D-CAD models. For example, to describe a dimensional measurement application a user would mark the measurement locations on the CAD model and specify the



**With a lens model connected to the camera the combined system provides simulated images as seen by the sensor**



Requirements can be specified in the VisionSystemDesiger software by annotating the 3D-CAD models




A user can enter vision system level requirements directly to model applications

desired measurement accuracy in mm with a sigma bound. For a detection application, a user would mark a location on the CAD model, specify the feature diameter in mm and the size of an image patch in pixel (e.g. 16 x 16) that will contain the feature. Specific annotation tools for several standard problems are implemented in the software. With such annotations, the VisionSystemDesiger software can then calculate component requirements such as a lens f-number, focal length, integration time, number of pixels on the detector, data rates, required object irradiance levels, type of lighting etc. A user can then compare different proposed lens, camera, lighting configurations and select the most appropriate system for a specific application.

## Semi-realistic Experience

The new VisionSystemDesiger software provides several benefits. A user can with the software evaluate the feasibility of a vision system application with respect to available hardware, simulate images as seen by the sensor and generate a report, which describes the vision system, the requirements and the performance characteristics. The semi-realistic user experience in the interactive environment also has a great potential if used in marketing, training or service. Three-dimensional visualizations of potential systems and components create a visual system understanding and can promote purchase decisions.

Application areas that would most benefit from the VisionSystemDesiger software are applications with multiple cameras, applications that require system performance analysis, and projects with constrained testing conditions. However, machine vision applications in general will benefit from documentation and optimized component selection and less time spend in the laboratory. In Summary: the VisionSystemDesigner software makes building vision systems easier.

## Reduced Field Tests

There are some limitations. Not all types of variations are simulated and image simulations involve approximations and cannot completely replace a field test. However, it is known which effects and type of perturbations can be simulated accurately and which ones are conceptual simulations. With this knowledge field tests can focus more on the remaining scenarios that are difficult to simulate. Vision system applications are also very diverse and the application level requirements in the software represent only a common but smaller set. For this reason, a user can also enter vision system level requirements directly to model other application types.

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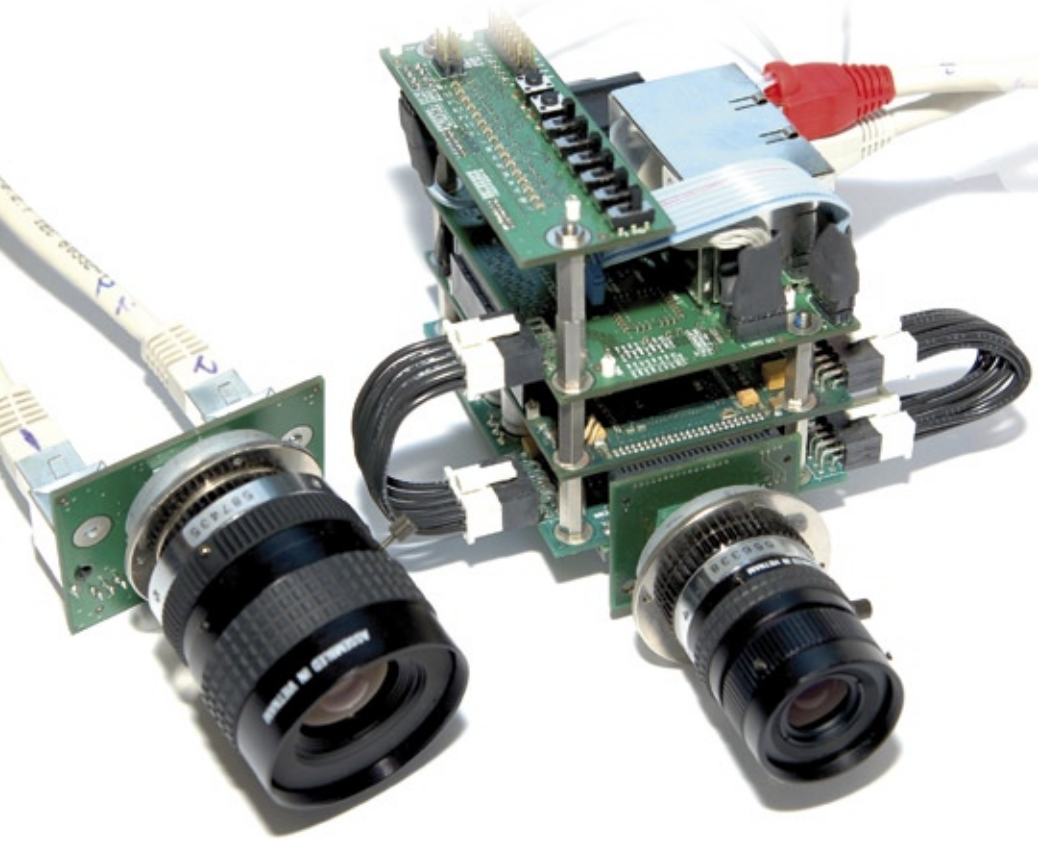
# Award-winning Concept

## Smart Camera Purely FPGA Based

**Early 2009 "Team Itava" of the University of Potsdam Germany made the first place in the Senior Coaching Competition. The team had developed a smart camera which, compared to existing products in the market, deliberately dispensed with the use of any software-based components within the camera. This leads to increased security regarding viruses, worms and Trojans. In addition the image analysis is executed significantly faster than a software solution can provide for.**



Itava Systems meanwhile became an innovative spin-off company of the German Institute of Informatics of the University of Potsdam which develops intelligent camera systems and smart image processing algorithms for challenging industrial applications.

### Ability to Reconfigure

The award-winning smart camera is based on a special designed platform which uses programmable logic circuits to run the image processing algorithms. By employing this innovative hardware solution it is possible to make use of the inherent parallelism inside the image processing algorithms to increase the performance compared to a software-only execution on even a modern multi-core processor, or existing intelligent cameras.

The hardware platform consists mainly of a board carrying a FPGA and memory chips. Due to the FPGA´s ability to reconfigure it is possible to create an optimized processing design for almost every industrial application. In case of high computing performance requirements, the system can be expanded by connecting additional FPGA boards and thus provide multiple blocks of programmable logic inside. The customers get a modular system that can be configured according to their specific needs.

### Versatile use by Individual Configuration

The Optor smart camera system of Itava Systems offers the advantage that it can be especially configured for all customer needs and thus forms a universal product for a wide range of applications. Among those applications are airports, military buildings, stations, depots and medical care facilities where the smart systems can contribute a valuable help to safety, quality and care.

For demanding quality assurance tasks, the QL product line was developed as a very robust solution for continuous operation. Based on the high performance of the FPGA-based image analysis, this system is able to guarantee the quality of the products even at high production speeds.

The scalability of the QL line allows the operation in both, high-end and in low-end applications. The camera system provides intelligent visual quality monitoring for production lanes and works autonomously and controlled from a central point. In the autonomous version the camera only uses its own dedicated resources without any need for resource sharing.

The smart camera system Optor by Itava Systems provides a cost-effective, easy to use, autonomous and robust inspection system for real-time industrial quality control applications.

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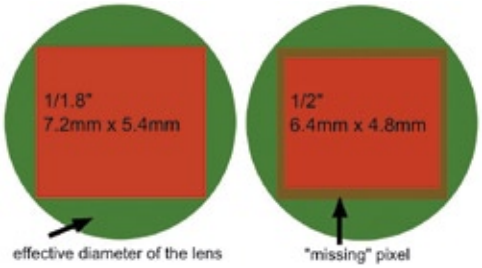
# The Definition of a Megapixel Lens…

…. is not yet standardized. Therefore every lens manufacturer can use their individual definition for Megapixel. To find such a definition is actually not that easy, because all kind of factors have an effect on the resolution of the lens. E.g. the resolution of a lens changes depending on the distance to the optical axis and also the used f-number or even the distance to the object can make a difference.

For some suppliers it is sufficient that the lens has the required resolution only in the center area, for others (like Tamron) the lens needs to have the Megapixel resolution on the entire sensor area. Tamron calls this a Flat Field Megapixel lens.

But what happens if a megapixel lens is used on a smaller sensor, will it remain a Megapixel lens?

Let's take a 1/1.8″ sensor with 7.2 mm x 5.4 mm sensor area. To obtain a pixel resolution of 1,280 x 960 pixel, a lens is required that can resolve app. 118LP/mm (based on a circle of confusion of 1.5). If we assume that the lens has a constant resolution, then on a 1/2″ sensor with 6.4 mm x 4.8 mm this would lead to a resolution of only 1,137 x 853 pixels and the lens is no longer a Megapixel lens.




Since so many factors have an effect on the actual resolution of a lens, Tamron does not mark their lenses with a fixed Megapixel number. Instead the users decide for themselves if the lens is sufficient for their application. A Tamron lens that is marked as a Megapixel will cover the lowest megapixel resolution on all applied sensors, at least…

In this way it is made sure that no matter if you have a Megapixel 1/3″, 1/2″ or 1/1.8″ sensor, the M118FMXX series will always give you Megapixel resolution.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**Bill Silver,**
Senior Vice President and Senior Fellow Cognex Corporation

# THE KEY TO SUCCESS IS PEOPLE

1969 2009

40 Years

**For forty years our authors have been inspiring the professional world by pinpointing solutions and sharing their foresight through our publications. Perhaps it is because of these visions that many of our publications are market leaders. One thing is for sure: We will continue to do what we do best – Inspire people. We call it „A Passion For Communication". Try us, today and in the future.**

↘ We are proud that Mr. Bill Silver is one of our prominent authors. Bill Silver is one of the most prolific and influential inventors in the thirty-year history of industrial machine vision. His most recent contribution appeared as an interview in our publication INSPECT, issue 4, 2009.

Bill Silver studied machine vision and robotics at M.I.T.'s Artificial Intelligence Lab, earning a Masters Degree in Electrical Engineering and Computer Science in 1980. In 1981, he left the Ph.D. program at M.I.T. to join the founding team of Cognex Corporation, where he created technologies that have had a profound effect on the direction of the entire industry. His work on optical character recognition, normalized correlation, and geometric pattern matching have become benchmarks for industrial part identification, alignment, and guidance. Most recently he has pioneered the use of motion to obtain unprecedented accuracy and reliability, once again establishing a new direction for the industry.

Mr. Silver holds 39 U.S. and foreign patents, with 55 additional patents pending. He received the AIA Technology Achievement Award in 1994, in 2005 he received the North American SEMI award with Cognex CEO Bob Shillman and co-founder Marilyn Matz in recognition of their significant contributions to the automation of semiconductor manufacturing.

In 2002, Mr. Silver was one of the principal witnesses in one of the most significant patent trials in recent memory, one that overturned the controversial Lemelson machine vision patents.

# A Tremendous Potential…

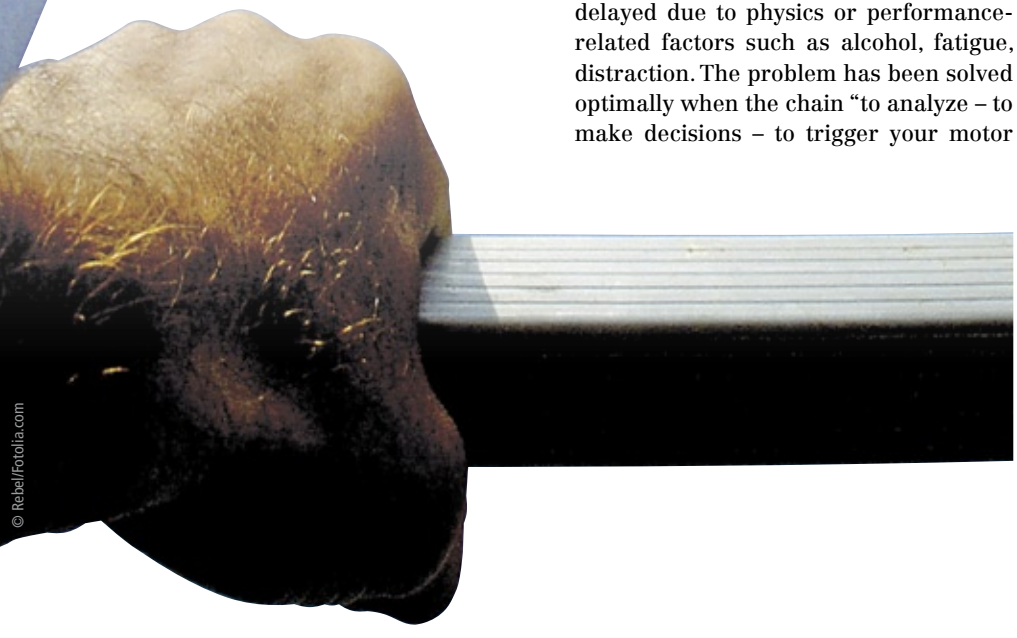
## Flexible Topology in GigE-Vision Systems Opens up New Possibilities

**Thanks to the GigE-Vision standard, standard Gigabit-Ethernet components can be used in Machine Vision and are already successfully being employed in multiple vision applications. However, the GigE technology can offer more: new topologies make the data stream simultaneously available to various receivers and reaction times can be reduced.**

The Ethernet technology transmits large amounts of data over great distances with utmost security and at reasonable prices. This could be achieved through comprehensive knowledge in the fields of communications engineering, HF technology and information technology. Thus, Ethernet is an example of how research and professional engineering skills from diverse disciplines combined to allow broad use. In the last few years, the question of applicability for heavy-duty Industrial Machine Vision tasks always took center stage during passionate discussions about interfaces. Closely linked to these debates is the question of the "real-time" requirement, or rather "in-time" requirement which gets to the core of what was really meant. In all digital bus technologies (USB2, IEEE1394 and also GigabitEthernet) pixel information is transported quasi serially and transmitted to the machine vision system. At first, there is no edge-related connection to the image sensor signals. But this is not disadvantageous over the classical analog or digital frame grabber systems but instead opens the floodgates to a variety of new possibilities.

### Take Nature as an Example

Nature serves as a good model for machine vision. Let's take an everyday situation to illustrate the chronological sequence from image processing right up to action. When a car driver meets an obstacle, they first have to realize the situation, then to analyze it and finally to make a decision. At the end of such a reaction chain he or she will determine the pressure to operate the foot brake. Stopping in front of the obstacle means that the processing chain is "OK" and thus within the range of physics and of human abilities. But, knocking down the obstacle means that the processing chain was "not OK". The processing time was too long or delayed due to physics or performance-related factors such as alcohol, fatigue, distraction. The problem has been solved optimally when the chain "to analyze – to make decisions – to trigger your motor skills" has been optimized in such a manner that there is no "bottleneck" left delaying the required operation. In the light of electronics this means: for processing, the image of a temporarily exactly defined scenario has to be transmitted to the computer's RAM as quickly as possible which is done via PCI bus systems (PCI-X, PCIe) which are no bottlenecks for large-scale camera data streams. This path is used for data transportation by systems equipped with an additional image acquisition board or with the available Gigabit Ethernet technology. This kind of image transmission contest does not put disadvantage to the GigE-Vision camera. So, when the PCI bus is faster than the data rate of image acquisition both technologies are on about the same level which can be seen from figure 1. As can also be seen, more functions have been integrated into current digital GigE-cameras. The camera as master of the vision system now has to manage the function block "A-D conversion", as well as the in-time communication with the outside world. Exact image triggering, light control and maybe also result control are done by the camera system.





### In-time Data Processing

Ideally, an image taken at time X is always to be processed at an inspection interval available. GigE-Vision camera manufacturers and software suppliers offer routines for managing the time-to-location reference of an image during the inspection process. It is quite often required to transform a result into an action at an exactly defined location in the machine vision system. To do so, the diverse system frequencies of the encoder, the motor control, and of the PLC have to be considered. As it was the case of frame grabber-based systems, it is an external or internal "time counter" hardware that helps the typical machine vision operating systems to obtain in-time results. Figure 3 illustrates how in-time data processing works. Any further sophistication in the GigE-Vision technology will most certainly lead to interesting solutions in the future.

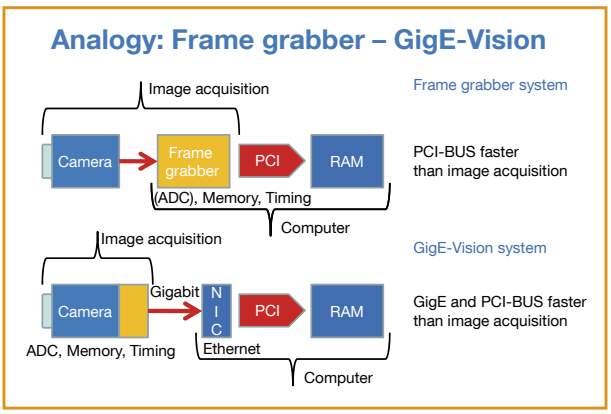



Fig. 1: Significant bandwidth available for GigE cameras

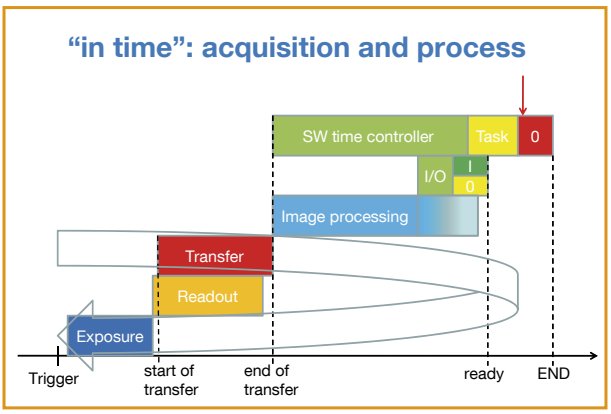



Fig. 2: In-time image acquisition and processing

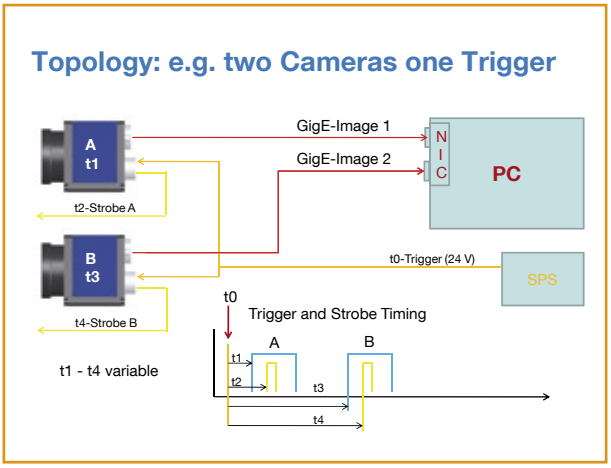



Fig. 3: The GigE Vision camera as master of the vision system

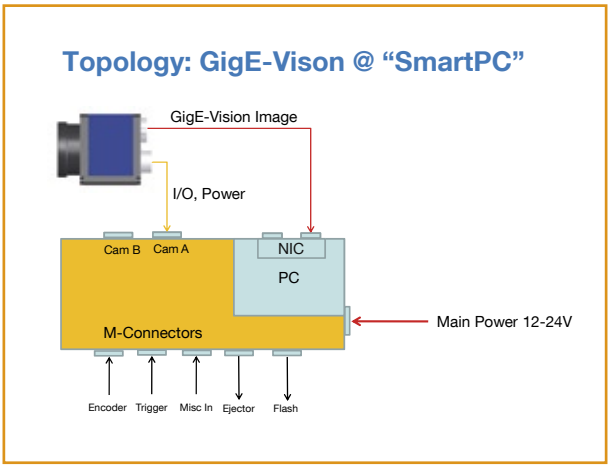



Fig. 4: Combination of a GigE camera and an "evaluation box"

### Double Interface

An optimally set up GigE-Vision connection can transmit about 120MB/s over a distance of 100 m – enough bandwidth to make use of the most current sensors, even high-resolution and high-speed sensors, up to the maximum image rate. Area-scan or line scan sensors with multiple outputs (e.g. 4 x 40 MHz) are a province of the Camera-Link interface. Still, this year products with a double GigE-Vision interface will come onto the market. Thus, the Ethernet technology will open up for further fields of application.

### Multiple Receivers

Multicasting, another specialty of the GigE-technology makes the data stream available to various receivers. This can be done with standard switches and illustrates flexibility and future potential. The topology of a machine vision application might be such that multiple computers simultaneously work with the images of the part to be examined and that the current live image is visualized on a network display.

It is also possible to combine diverse camera systems. A line scan camera and an area scan camera will acquire images at the same switch within the bandwidth available. Of course, all cameras in the network can operate entirely asynchronously or event-driven.

To ensure reliable operation of a new GigE-Vision system even in heavy-duty continuous operation, all general conditions have to be defined in advance as clearly as possible. As in any other acquisition technology, the description of the customer's task defines an approach to a solution comprising camera, illumination, optics and processing technology. Expert knowledge or experience will still be in demand when the topology of a GigE system has to be realized. The market will soon bring out simple and yet flexible combinations of a GigE camera and an "evaluation box" (see fig. 4) which will attract attention due to a surprisingly good price-performance-ratio.

### Conclusions

GigE-Vision is already being used effectively and was made ready for the market. Just as today's PCs gained their permanent place in machine vision (MV), the GigE-Vision standard will prevail in future MV applications. Ethernet is also gaining ground in the field of machine control.

Those who work at the somewhat different "cabling concept" of the new topology of their systems will soon discover chances enabling them to offer smart inspection machines with customer value. However, it's beyond dispute that image acquisition boards will maintain their ground. New acquisition boards also arise on the basis of the GigE-Vision interface (e.g. with multiple inputs) which process the image data on the board. Thus, less CPU time is required, or even shorter "in-time" processing can be realized by means of selective measures.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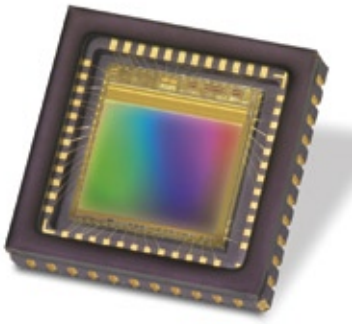
## New High Spec 1.3MP CMOS Image Sensor



Featuring dual 'true global' and 'rolling' shutter modes, the EV76C560 is the first in a family of high-sensitivity CMOS imagers aimed specifically at industrial machine vision, barcode scanning, surveillance and other demanding imaging applications. This new device is ideal for applications requiring superior low-light performance or where very short integration times are necessary (for example in high speed video streaming applications), or where illumination power must be minimized. The 1280 x 1024 imager comprises 5.3µ pixels with a unique architecture that assures very high efficiency global shuttering (3000:1) while maintaining excellent quantum efficiency (QE). It outputs full resolution images in a 10 bit parallel format at 60 frames per second.

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

## Brilliant Color Cameras with Virtual 3CCD Technology

Baumer's HQ-Color GigE cameras are equipped with an advanced color processor that produces brilliant color rendering. Targeted for food, pharmaceutical and life-science applications, these cameras use special software algorithms to deliver a virtual 3CCD image with only a single CCD sensor. The cameras using CIELab for the internal color management deliver brilliant color images with enhanced edge sharpness. Additional sophisticated features include real-time color management as well as integrated image scaling. With a robust and compact housing measuring just 36 x 36 x 58 mm, the TXG06ac as the first camera of the HQ color line captures images with a resolution of 776 x 582 pixels and can be integrated into even the smallest spaces.


*Baumer Optronic GmbH · Tel.: +49 3528 4386 0*
*sales@baumeroptronic.com · www.baumer.com/cameras*

## New Series of Gigabit Ethernet Cameras

The Imaging Source has just brought to market a new series of Gigabit Ehernet cameras, available in 27 models. The cameras ship in robust industrial casing with a C/CS lens mount and optionally with a trigger and digital I/Os. The color, monochrome and Bayer models are available in VGA, XGA and SXGA resolutions. The software support of the cameras leaves nothing to be desired: Both programmers and end-users immediately feel at home. Getting started with the cameras is a matter of minutes and integrating them into existing applications takes only a few lines of code. Drivers for LabView, Halcon, DirectX, Twain and WDM are included. All camera parameters and settings can be set via the shipped software. Furthermore, a number of automatic modes are available, which guarantee optimal image quality in varying light conditions.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*info@theimagingsource.com · www.theimagingsource.com*

## Image Analysis Software

As a system integrator Simon IBV has specialised in software for checking and evaluating product image data. Aim is an efficient analysis of manufacturing errors and an optimisation of the manufacturing process. With the image analysis software Simavis P the company offers an ideal solution for beginners and professionals. It disposes integrated test and recognition functions. Above all, however, existing ProVision programmes can be integrated into the software, so that for programmers by the announcement of discontinuation of the Simatic vision sensor VS710 no migration bottleneck originates.


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*Tel.: +49 9201 91742 20 · info@simon-ibv.de · www.simon-ibv.de*

## High Speed Line Sensors

Awaiba's digital high speed linescan sensors provide low noise of 7e- at 40kS/s and 12bit. The sensors are available with 2k, 4k, 8k and 16k and 7x7µm²; 7x500µm² or 3.5x3.5µm² pixels, all with 100 % fill factor. The high sensitivity and dynamic range over 70 dB make these sensors the ideal choice for high speed web inspection and spectroscopy.

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## Optimized Live Image Display

IDS Imaging Development Systems announces the release of Direct3D support for optimized display of live images. The new driver is part of IDS' latest uEye software package version 3.40 and it includes additional overlay functions and options for synchronizing image rendering to the monitor refresh rate. This eliminates undesired image tearing which is the result of unsynchronized image acquisition with image display. The Direct3D mode is particularly useful in vision applications where the goal is visualization. The driver update is compatible with all USB and GigE industrial cameras of the uEye family. PCs equipped with the latest DirectX Runtime version can run the new graphics functions of the Direct3D interface right out of the box.

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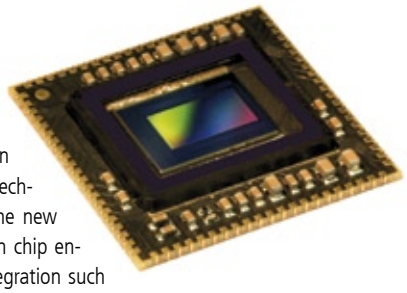
## Image Sensor



The Thomson HDTV-CMOS image sensor is a high performance, low power, 2/3" sensor with a resolution of 1920 x 1080 pixels. Based on its ground breaking CMOS image technology for the broadcast industry, the new Thomson Sensor is a next generation chip enhanced for industrial application integration such as machine vision, medical imaging and high-end video surveillance. The Sensor also includes control electronics, which allow to use various scanning modes such as progressive scan, interlaced formats, vertical scanning and others. The Imager features high dynamic range (greater than 120 dB in nonlinear modus), outstanding sensitivity, on-chip dual 12 bit A/D converters and 90 frames per second. In summary the sensor delivers full resolution, high quality images in a large variety of lighting conditions.

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## Cost-effective TDI Cameras

Dalsa announced the availability of a new line of Piranha ES cameras for machine vision applications. With various models in the ES line, these new Piranha cameras deliver cost-effective solutions with Time Delay and Integration (TDI) technology; the same leading edge technology used in Dalsa's HS (High Sensitivity) TDI cameras. TDI is a method of line scanning which provides dramatically increased responsivity compared to single line scanning methods. TDI permits much greater scanning speeds in the same lighting condition, or allows reduced lighting levels, and costs, while maintaining the same speeds. The Piranha ES line brings an incredible combination of speed, resolution and sensitivity to low-light applications, bridging the sensitivity gap between single line cameras and the highest sensitivity Piranha HS series (selectable to a maximum of 96 stages).

*Dalsa*
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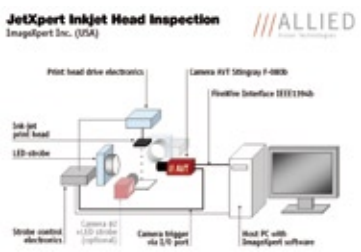
## Inspects the Properties of Ink Jets for Printers




ImageXpert is an American company specializing in imaging solutions for quality assurance and printing technology. To support companies using print heads from manufacturers such as Dimatix, Xaar, Kyocera, Konica-Minolta, Epson and Ricoh in their development and quality control, ImageXpert developed a system to precisely analyze a print head's ink jet with the aid of cameras and proprietary LED strobing technology and analytical software. The JetXpert system is available in a one-camera or two-camera configuration using digital cameras from Allied Vision Technologies. The camera is a Stingray F-080b model. This monochromatic camera is equipped with an XGA (0.8 megapixel) image sensor and a high-speed FireWire IEEE1394b interface.

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## Visual Surface Inspection

LDV-Systeme has been commissioned by Converteam GmbH with the supply of several iLux light systems. The systems will be used at the galvanizing and continuous annealing lines built as part of the "Compass" project of Thyssen Krupp Steel. They will inspect the strip for surface defects that cannot be classified by automatic inspection systems. TKS will use the lighting systems for visual surface inspection at four lines of its new rolling mill in Alabama. At each line LDV will install two lighting systems for inspecting horizontally and one for the inspection of vertically running strip. The installed mirrors will enable the inspector to observe both strip sides at the same time. The decision in favor of iLux was due to the fact that TKS had been using the previous generation of the systems at several galvanizing lines in Germany for many years. The systems have proved highly efficient and have become an integrated element of quality assurance in strip production.

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## Intelligent Camera with Remote Sensor

For challenging OEM applications with tight or angled installation space VRmagic now offers an intelligent camera with a remote and freely positionable sensor which is connected to the central unit by an up to 50 cm long flex-foil-cable with LVDS transmission. The size of the sensor board is only 28 x 19 mm. Equipped with the DaVinci processor from Texas Instruments, the components feature a 300 MHz ARM9 processor running Debian Linux as an autonomous standard operating system and a 600 MHz DSP with 4,800 MIPs. Developers can transfer their own algorithms to the camera from a PC using a cross-compiler, since both the host system and camera have the same API. An FPGA module for preprocessing the image data is optionally integrated into the camera. The overall camera performance is optimized through distribution of computing processes to ARM, DSP and FPGA (load balancing).

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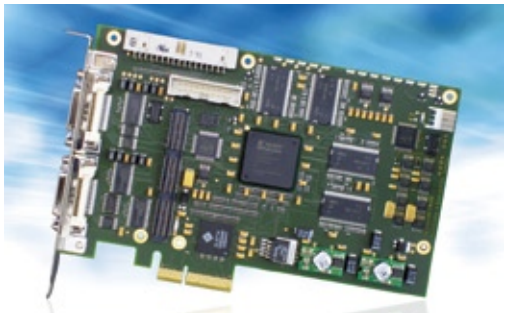
## Frame Grabber Product Series Extended



With microEnable IV AD4-CL, Silicon Software introduces a new CameraLink board in the high speed frame grabber range with support of two independent BASE configuration up to one 10taps FULL configuration camera. Besides a support of all available sensor types, a wide range of real-time preprocessing functions for image corrections and enhancements are implemented. microEnable IV AD4-CL is equipped with a x4 PCI Express interface and supports a sustainable transfer rate of up to 780 MB/s. In parallel Silicon Software reorganizes its frame grabber product line. The new A- and V-series address different customers. While the A-series is focused on a powerful and reliable image acquisition with integrated image correction and image enhancement features, the V-series additionally supports programmability and partial solutions for applications.

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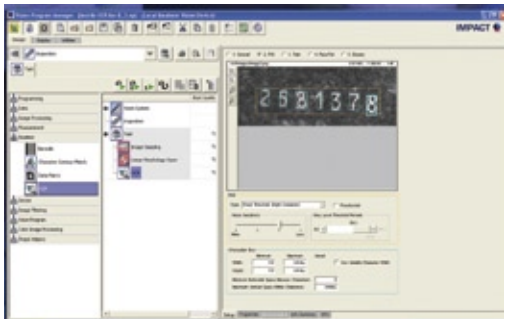
## Increased Functionality



PPT Vision announces Impact Software Suite 8.3, the latest installment of the company's powerful, easy to deploy vision software. Impact 8.3 pairs with smart camera technology to provide enhanced usability and inspection capabilities for challenging machine vision applications - in a multitude of new ways. Setup tools assist users in creating a vision inspection, guiding them through many common vision tasks and significantly reducing operator learning curves. These tools ensure even users with minimal programming experience can efficiently create powerful, accurate inspection solutions. Included in the Impact Software Suite, which accompanies PPT Vision's selection of smart cameras, is the Vision Program Manager (VPM), which now offers more than 120 tools including code reading, pattern find, blob analysis, circle gauge, line find, and sub-pixel gauging.

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## Series Production of the Aviator Area Scan Camera Series

Basler Vision Technologies is starting series production of the new Basler aviator camera series. Based on Kodak's new KAI-1050 CCD sensor with a resolution of 1024 x 1024 pixels, this camera series pushes the speed barrier to a new height of 120 frames per second. Progressive scan readout and global shutter technology combined with a Camera Link data interface make the aviator camera well suited for various application areas such as semiconductor and electronics manufacturing, metrology, or medical imaging. As a result of Basler's extensive CameraLink interface and Kodak sensor experience, the aviator offers excellent imaging results in terms of dynamic range and noise level, factors that will be measured and documented for each camera by automated EMVA 1288 sensitivity testing during production.

*Basler AG*
*Tel.: +49 4102 463 500 · bc.sales.europe@baslerweb.com · www.baslerweb.com*

## New Vision Tools for Solar Cell Inspection

Cognex has further expanded its range of inspection solutions for solar cell manufacturing processes. The new VisionPro Solar Toolbox includes pre-configured software tools for the most common vision alignment and inspection applications in photovoltaic (PV) solar production. With the addition of the Solar Toolbox, users have the option of working either with the basic VisionPro software library, or using the pre-configured tool set as a starting point for setting up vision inspection and alignment applications. VisionPro software's full range of industry-leading tools for location, identification, and inspection can also be leveraged throughout the value chain to help manufacturers achieve higher quality, faster throughput, and better process control.

*Cognex*
*Tel.: +33 1 47 77 15 21 · support@cognex.com · www.cognex.com*

## Kappa High Definition Vision Camera with GigE Vision

Kappa introduces a new vision camera based on our modular high-performance platform with 14-bit digitization. The first model, the Zelos-02150 has a GigE Vision interface and offers a resolution of 1920 x 1080 p and a frame rate of up to 30 fps. It fulfills all typical Kappa quality characteristics regarding hardiness and longevity. The camera features several technical highlights. One of them is the 2/3" Kodak sensor KAI-02150, which supports 1080 p and excels with an excellent dynamic range and the best image performance. A further plus is the high-performance GigE Vision interface. This creates a perfect combination of a high transfer rate (1 Gbit/s), a low-priced interface on the PC, inexpensive cabling with thin CAT5e cables up to 100 m (300 feet) and a standardized user-friendly communication protocol.


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## New Industrial Grade 3D TOF Cameras

Mesa Imaging is a leading company in the supply of 3D Time-of-Flight (TOF) cameras. TOF cameras are based on the principle that each of tens of thousands of pixels determines the distance from the camera to the object via a highly accurate time delay measurement. Mesa cameras are capable of creating 3D maps in real time (>30 frames/second) of a scene with a resolution more than 25,000 pixels. The SR4000 is designed for the use in an industrial environment and is now available for a measurement range up to 10 m with USB or Fast Ethernet interface.

*Mesa Imaging AG*
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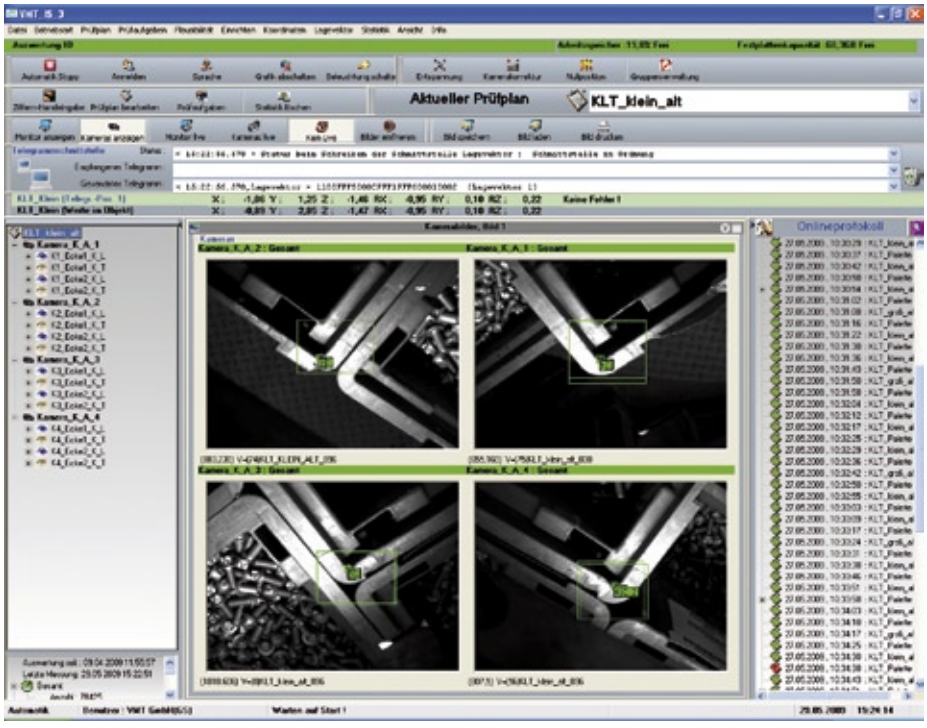
# Modular, Efficient, Versatile

## Platform Strategy for Automated Material Handling

**Part unloading or robot-aided depalletizing are sought-after industrial applications for automating production processes, increasing capacity and cutting costs. When the parts to be handled are unknown and the position within the container is random, the machine vision system is required to identify these parts and to localize the part position in 3D.**

Unloading parts from containers, e.g. before assembling processes, is a simple exercise for humans. It is more difficult, when a robot has to undertake this task. If form and position of the parts in the container are known, it's a pick-and-place-task: a standard in robotics. But if the robot has no detailed information about the objects in the container, and these objects are positioned randomly, the technological challenge is huge and the environmental conditions are complex. In the most challenging scenario, the vision system must be capable of recognizing a hitherto unknown position scheme, in order to subsequently be able to identify a hitherto unknown part. The problem is known in the industry for years as "Bin Picking". To solve this task, special know-how is needed from diverse areas of metrology like optics, illumination, sensors and algorithms. Particularly important in practice are operability aspects like re-calibration and re-installation, traceability, failure analysis options, process documentation, system handling, availability, and prevention of pseudo defects. In addition, the sensor should be easy and quick to change in case of failures.

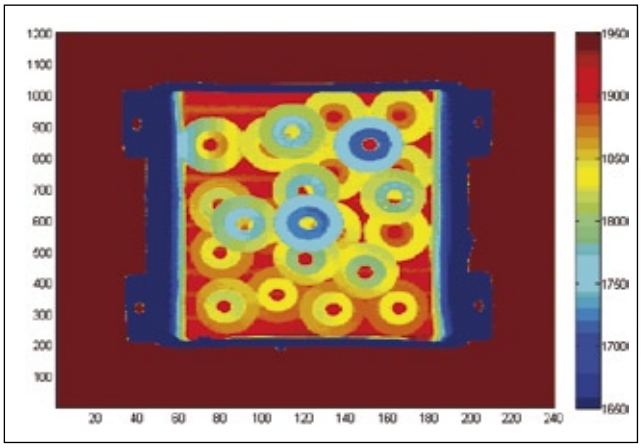



The operator panel for the depalletizing of containers

The concrete task of the sensor system with "Bin Picking" is to define the 3D position of the parts to be handled with adequate accuracy and speed rate. This leads to the calculation of position correction data and transmission of these data to the handling device.

### Uniform System Platform

Thanks to dynamic development in the area of sensor technology, there is a multitude of highly efficient sensor technologies available today. There are the classic gray-value and color cameras which gather images or image matrices. Furthermore, triangulation sensors detect distances and height contours and determine 3D height profiles. At last TOF (Time of Flight) sensors allow LIDAR measurements to base the calculation of distances, height contours and 3D height profiles on, in effect similar to the data calculated from laser triangulation sensors. Moreover, the availability of high performance hardware allows for the application of computer intensive algorithms, so that even complex mathematical methods can be implemented. So far, existing systems have focused on solving only individual task classes. Any change in the task specifications or environmental conditions (ambient light, new containers, range of part characteristics, such as geometry or color) usually requires extensive interventions, modifications and expansions, in order to adjust the new task setting to the task-specific sensor system. The system approach of the company Vision Machine Technic Bildverarbeitungssysteme (VMT), however, pursues a modular strategy. It is based on the industry-proven functions



**The software recognizes the position of the brake disks**

of the current VMT system solutions, on the one hand, and the integration of new applications into the open system architecture, on the other hand. The second important aspect of this platform is the end-to-end employment of as little as possible different but carefully selected hardware components of renowned manufacturers. This helps to avoid compatibility problems at later system adjustments.

## Put into Practice

To solve the most diverse tasks, VMT developed multi-sensor systems with a number of highly effective functions, yet with the aim to keep the system transparent and easy to use for customers.

Bin-picking tasks can be graded into different classes (see table). For these classes two fundamentally different recognition models can be formulated: The part to be handled is known (case 1) or it is not known (case 2).

In case 1 the known part is described mathematically. For this the object's geometry and properties, for example the color, are recognized. This model is used, e.g., for the unloading of door hinges from SLCs (small load carrier). The sensor signals are provided by a TOF sensor placed on a linear axis or at the robot's hand.

In case 2 where the part to be handled is unknown, the recognition model describes the object's properties like "The part contains areas with a minimum size of". Based on this information it is calculated to which location the suction gripper of the robot needs to be positioned. Another object property might be "The object is round with a hole in the middle". A gripper designed for this operation can then dip into this hole.

An example for this class would be the unloading of bulk material from a SLC. The bulk material consists of different shaped parts. For this task a triangulation sensor is placed on the robot's hand. The exact 3D position of the parts to be gripped and the part type is then determined by the connected 3D camera system.

Another sought-after application is the depalletizing of small load carriers (SLC) or VDA boxes. The SLCs to be depalletized are provided on a pallet and placed at a random stacking order. There are up to four different SLC types in a multitude of different colors. Firstly, a TOF sensor on a linear axis is used to determine the stacking scheme and to recognize the part type of the SLC to be gripped next, as well as its approximate 3D position. The gripper which the robot moves over the SLC contains four cameras. With a single image acquisition the 3D gripping position is thus calculated within a fraction of a second. The storage of the SLCs in the high-rack warehouse of the goods-receiving area can thus be executed fully automatically. The only manpower necessary is for transporting the pallets with SLCs with a stacker from the shipping truck into the small parts warehouse and for removing the empty pallets.

In order to make these solutions industrially applicable, a number of additional basic functions are provided: gripping feasibility analysis, "container -empty" control, collision prevention, checking the container for damages, definition of container and/or unloading po-

A robot depalletizes small load carriers automatically

Brake disks are supplied in transport containers

## Task Classification

| | | |
|---|---|---|
| Class 1 | Position scheme is known | Part type is known |
| Class 2a | Position scheme is **unknown** | Part type is known |
| Class 2b | Position scheme is known | Part type is **unknown** |
| Class 2c | Position scheme is **unknown** | Part type is **unknown** |

Position scheme: Arrangement of parts within transport carrier
Part type: Form and color of the part to be gripped

sitions, automatic calibration etc. The sensor system can also assume additional functions, such as type recognition, inspection and reading (plain script, barcode/matrix code). Integration of these tasks in the VMT system is easily feasible thanks to the system's uniform platform.

### Conclusion

Different task classes can be derived from the versatility of practical applications in the area of material handling. Solutions for these tasks within the individual classes require special functionalities of the sensorics (algorithms, functions, sensors). VMT offers a platform of available solutions whose functionality may be expanded for the purposes of each new application, on the one hand, or combined with other functions available in the VMT system, on the other, depending on the complexity of the given project. Since the platform is fundamental, application independent, and expandable, it is possible to also use it – in addition to or in combination with the above-described robot guidance tasks – for applications in other areas, such as inspection, type recognition and code reading.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# Salt of the Earth

## All New Special Platform for System integrators at Vision Trade Show

**The biggest obstacle on the road to success for machine vision in the new markets of East and Central Europe, China, India, Russia or Brazil, is by unanimous vote the lack of system integrators. It is the integrator who forms a solution out of products and components, a solution he is responsible for towards the end customer. The requirements for such a solution provider are high.**

Machine vision is an interdisciplinary technology, embracing such diverse fields of technology as lighting and illumination, optics, electronics, information technology, mechatronics and automation technology. But this is not all. To successfully master a turn-key solution the detailed understanding of the end customer's processes and products, with all the unavoidable fluctuations, is mandatory as well. But again this is not all the system integrator of machine vision has to be versed in. He also needs to be able to integrate the vision system electromechanically into the customer's machine or process, to interface with PLC, robots and data bases and to train the customer's staff well enough that they'll embrace the new technology. This is more often than not connected to the requirement of 24/7 on 365 days a year, preferably with a reaction time of no less than four hours for service calls.

It takes very special companies to meet all of these challenges; and more often than not it takes a small company to comply. With this type of business there are no millions to make; and it takes a high degree of flexibility and dedication from the staff as well as the courage for entrepreneurial risk on the shareholder's side. Quite a few of the system integrators work mainly locally to ensure the short response times for their customers. And for a lot of these companies the CEO is at the same time the CTO or the Sales Manager for the company. No surprise then, if you do not encounter too many of these companies at any given trade show.

Now, for the first time ever, the Vision trade show provides a special platform, the Vision Integration Area, to promote the system integrators. The goal of this platform is it to minimize the administrative effort for the participating companies so that they can fully concentrate on displaying their range of systems and services.

Convinced that the system integrator is the "salt of the earth" in machine vision, the INSPECT supports this platform as sponsor. Find out more about the companies that present themselves at the Vision Integration Area 2009:

### alfa vision systems

alfa vision systems is a leading provider of machine vision for over 10 years now and has under their belt the experience of several hundreds of successful installations in a multitude of application areas. The company positioned themselves in the broad field of machine vision with their extensive know how as solution provider in the area of quality control for the production of mass products. This competence, combined with the in-house development of the alfa vision system architecture, guarantees the fast and economical implementation. The solutions of alfa vision systems provide the end customer with a stable and reliable tool for 100 % quality inspection during the production process. The customers of the company derive from the areas of automotive, aerospace, electronics, machine building and the packaging industry.

### Bi-Ber Bilderkennungssysteme

The company Bi-Ber Bilderkennungssysteme was founded in 1997 in Berlin. The main area of activity for the company is the development and the deployment of vision systems for quality inspection during production processes. A highly qualified team of engineers and software developers takes on the tasks of system integration for the solution of customer-individual applications. As system solution provider, Bi-Ber offers platform-independent integration services for optical metrology tasks, providing this application- and/or customer-specific. Independent from the choice of smart camera or PC-based system, or automated production versus manual inspection area – from feasibility test via field test to the execution including commissioning and service, the customer will be supported with the solution for his machine vision application.

### Hengstmann Solutions

Hengstmann Solutions develops and supplies very economic but at the same time high performance machine vision solutions. The company works cross-sectorial in a broad range of industrial areas. For the quick design of system solutions Hengstmann relies mainly on the self-developed software platform HS-AutoInspekt. The performance of HS-AutoInspekt is achieved, among other things, by the implementation of one of the world's best machine vision software libraries. The multi-tasking capability of HS-AutoInspekt allows the optimal usage

of resources, since several machine vision tasks run in parallel on one PC, without constraining each other. This also provides for a cost-effective enhancement of existing systems.

### in-situ

The business focus of in-situ, founded in 2001, is the area of imaging and machine vision for industrial, medical and scientific applications. At in-situ the customer does not only get the complete range of products necessary for image analysis, but one focus of the company's activities lies in the professional manufacturing of customized solutions as well as the design and supply of complete turn-key systems. The underlying company philosophy is the competent and flexible problem solving in close cooperation with the customer. Following this goal, own developments are used as well as components from reliable third party suppliers. In-situ, as a small and very innovative company, provides for an environment where the creativity and the responsibility of each employee are supported. Customer tasks are approached based on a wide leeway for creation, and the customer is convinced regarding the company skills by technological competence, individual attention and honesty. Honesty also means that every now and then it has to be clearly stated that something does not work.

### isa industrielektronik

isa industrielektronik plans and realizes automation, electronic and software solutions and is thus a competent partner for all companies with an interest in enhancing their technical products and machines with innovative technology. The company was founded in 1994. A strength of isa industrielektronik lies in the development of electronic controllers, which are either build as a prototype or optimized for production, depending on the customer demand. The software know how is strongly focused on the development of individual application software. Via individually programmed interfaces the customer's systems are enabled to communicate production data to commercial systems like ERP and others. The company is proud to provide innovative solutions customized for the specific tasks of the wide areas of electronics and automation the customers post to them.

### Kaiser Computersysteme

Since 1989 Isotronic Bildverarbeitungssysteme, in cooperation with Kaiser Computersysteme, provides optoelectronic measuring and inspection systems. Branded IsotroniKa both, standard vision systems and customizes solutions, based on top-quality and innovative technology are offered worldwide for almost every industry. The modular hardware setup of these machine vision systems is based on an open PC platform and thus offers a high degree of flexibility. The system is employed as standalone system as well as an integrating part of automation technology. A further field of activity for IsotroniKa is the design and production of customized solutions for automation. This comprehends the complete area of inspection with the required control units for handling and transportation.

### NeuPro Solutions

The company was founded in 1998 and is active for about 20 years now in the field

of machine vision and for about 15 years in the field of robotics. In close cooperation with competent line builders systems are developed based on programming in C, Visual Basic, Java, SQL, PLSQL. Typical tasks are customizing of components for specific customer requirements, system integration into existing production environments and data connection into Oracle, SQL and customer specific databases. From the customer's point of view the benefits of the multidisciplinary competence of NeuPro Solutions is the elimination of single component search due to the provision of a system solution build from carefully selected components based on latest high performance technology with proven system functionality, and an overall responsibility taken over by the core supplier, NeuPro Solutions.

### pi4_robotics

pi4_robotics is a leading high tech company in the areas of robotics, optical inspection, marking and components. In addition the scope of the Berlin based company also includes software and systems up to turn-key inspection machines. For 15 years now the company aims at quality, innovation, high customer value, outstanding performance and customer service, all while delivering on schedule of course. pi4_robotics' inspection systems inspect and ensure the customers' high production quality at short inspection times, high optical resolution, ease-of-use and low follow-up costs.

### weitblick systems

weitblick systems, having made their first steps in 2006 in a small garage, positioned themselves during the last couple of years in the markets of machine vision and software engineering. The company is a well respected specialist for customized solutions in machine vision and already successfully installed these systems in Austria, Germany, the Czech Republic and in Hungary. Especially the complete range of services from first consulting to final system installation is convincing for the customers. The year of 2008 could be concluded with being awarded the Schrittmacher (pacemaker) award. This highly coveted prize is granted to exceptionally innovative companies. Weitblick systems could convince the jury in the category of companies below nine employees. The company today is five people strong.

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www.alfavisionsystems.com
www.bilderkennung.de
www.hengstmann.biz
www.in-situ.de
www.isaweiden.de
www.isotronika.de
www.neupro-solutions.de
www.pi4.de
www.weitblick-systems.at

# 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**
**3.–5.11. 2009 in Stuttgart, Germany**

VISION 2009

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# The Needle in the Haystack

## The Quest for Tiny Flaws on Large Surfaces

**To find a flaw not larger than a few micrometers on a surface spanning several square meters is a difficult task. A northern German company took up the challenge and constructed an inspection system just with standard components to find flaws on large surfaces in an appropriate time frame. How the company's engineers completed the task, what technology has been used to find the flaws and how the data is validated is presented in the following article.**

Optical quality inspection is an established field, but assume one needs to produce a 1,500 by 1,000 mm panel that can have various types of defects in the size range of a few micrometers: who is going to inspect that? Obviously, we require an automatic inspection system that can inspect large objects with a high resolution in a reasonable amount of time. The first step in developing an affordable technology for this problem is to use standard mechanical and optical components. To obtain the desired resolution, both mechanical and optical inaccuracies must be compensated for in software, for example image registration is used to compensate for positioning inaccuracies. A standard megapixel camera, a macroscopic zoom lens, and flashed LED illumination define the core of the scanner (see fig. 1). In cases where 3D structures are to be inspected, we employ more sophisticated illumination techniques like, for example, photometric stereo. At a frame rate of 20 frames per second and a resolution of 4 micrometers per pixel we scan the above-mentioned panel in about an hour (see table 1 for example calculations). Alternatively, by using a microscope, our customer could maybe manually inspect samples of the panel and spend a few days before making a proper decision.

### Estimate the Density

The main challenge however is not only to deliver a large high-resolution image but to detect the defects on the fly and deliver error statistics for the whole panel and the different defect types. In addition to providing error-density maps for the panel, optimization routines are used to estimate the regions of lowest error density in case that only certain parts of the panel may be used. Defects can be

Fig. 1: Components: The scanner is build with standard components only, i.e. conventional cameras (left), lenses (middle) and illumination (right); the mechanical parts are also standard industrial components.

of two sorts: (i) more or less well defined defects for which the customer can provide sufficient samples for each error class, and (ii) defects that must be determined as deviations from a regular surface. In both cases we employ proprietary state of the art machine-learning techniques that go well beyond standard tools. For example to detect complex deviations from a regular surface texture, novel one-class classifiers have been developed [1].

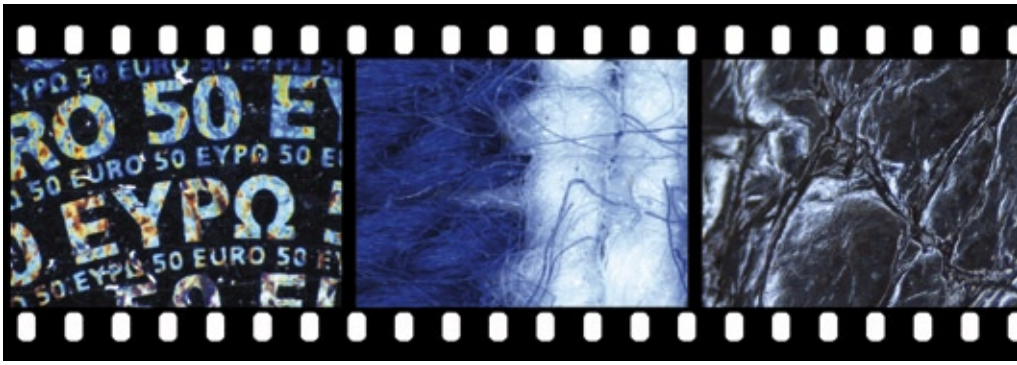

Fig. 2: Sample scanner images (for illustration purpose only): 50 euro bill (left), fabric (middle), leather (right). Images recorded with 4 micrometer per pixel (and 4:1 optical enlargement).

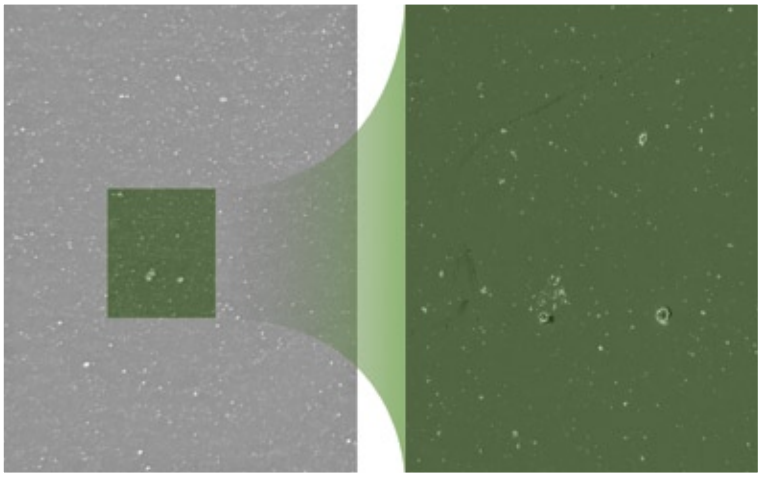

Fig. 3: Validation: What is the cause of the observed image structure? This is a key question when inspection systems are used to optimize the production process. Here a test object is imaged with the scanner (left) and with a scanning electron microscope (right) to analyze the correspondences and validate the inspection system.

Table 1: Overview of system parameters that are used to illustrate system performance

| Parameter | Description/Formula | Example value |
|---|---|---|
| PanelWidth, PanelHeight | Dimensions of the panel [mm] | 1,500 x 1,000 |
| SensorWidth, SensorHeight | Dimensions of camera sensor [px] | 1,392 x 1,040 |
| Resolution | Desired resolution [mm/px] | 0.004 |
| Overlap | Overlap between successive images [%] | 20 |
| ColorDepth | Color depth (typically 8 bits for gray value images and 24 bits for color images) | 24 |
| Framerate | Number of frames per second | 20 |
| ImageArea | Area covered by a single image (ignoring the overlap) [mm²] SensorWidth * SensorHeight * (1-Overlap)² * Resolution² | ≈ 15 |
| NumberOfImages | Number of images required to cover the whole panel PanelWidth * PanelHeight/ImageArea | 100,000 |
| Memory | Memory required to store all (uncompressed) images [GigaByte] SensorWidth * SensorHeight * ColorDepth * NumberOfImages | ≈ 400 |
| Bandwidth | Amount of image data per second [MegaByte/sec] SensorWidth * SensorHeight * ColorDepth * Framerate | 82.8 |
| ScanTime | Time required to scan a complete panel [h] NumberOfImages/Framerate | ≈ 1:23 |

## Avoid Bad Products

One of the most serious problems with these kinds of applications is validation. Therefore, we have developed techniques that allow to find correspondences between the images taken with our scanner and other more sophisticated imaging techniques like the scanning electron microscope (see fig. 3). In most cases we inspect low-batch expensive panels. These panels are inspected at various stages using comprehensive error statistics to reject defective parts as soon as possible. However, our goal is not only to sort the good and bad, but to deliver a comprehensive error analysis that can help to improve the production process and avoid deficient products. The ease and speed of scanning, the comprehensive error analysis, and the sophisticated validation process can help to better understand and optimize the production process.

## Conclusion

We conclude that state of the art machine learning and pattern recognition techniques can be used to automatically detect complex error types and deviations from defined quality standards in case of high-resolution inspection of large objects. Moreover, comprehensive statistical evaluations can be used to optimize the production process. Based on intelligent software design all this can be achieved with standard components at affordable cost.

## Reference

[1] Fabian Timm, Sascha Klement, Thomas Martinetz, and Erhardt Barth. Welding inspection using novel specularity features and a one-class svm. In *Proceedings of the Int. Conference on Imaging Theory and Applications*, volume 1, pages 146-153, Lisboa, Portugal, 2009. INSTICC.

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# Optimal Combination

## Sensor Solutions for the Photovoltaic Production

**In the German Conergy factory four robots assemble solar cells to matrices. Smart cameras, integrated on the soldering heads of the robots, manage the precise position detection of the cells. Displacement sensors take care of the high quality in final assembly through the exact determination of the protective film's edge position.**




The industrial vision camera IVC-2D guides the soldering heads to assemble the solar cells

Robots deposit the foils and soldering ribbons and position the soldering points accurately, based on the part position location

In its German solar power systems factory Conergy produces photovoltaic modules capable of generating an annual output of 250 MW. For this, five fully automated assembly lines run with more than 40 industrial robots from ABB on a total production space of 35,000 m². The solar cells are transported from the cell production to the module manufacturing area. Next, the individual solar cells are fed to the five autonomously operating production lines. There, the solar cells are connected automatically into a chain of cells (string) by the so-called stringers. The task of connectivity of individual strings into a matrix – the actual photovoltaic module – is carried out by four robots per line, each of the IRB 1600 series. In this step precision is essential.

### Smart Camera Controls Soldering Head

Two of the four robots are equipped with a special suction gripper, and they handle the soldering blocks, insulation foils, and soldering ribbons. The two other IRB robots operate one soldering head with integrated IVC-2D Smart Cameras. The cameras help to determine the orientation and position of the cells and of the small soldering ribbons on the top and bottom of the module. The industrial vision camera detecting in 2D offers resolutions of 640 x 480 up to 1,024 x 768 pixels, combining the latest image processing technology with a highly efficient program library for image evaluation. Thus, over 100 software tools are available. They can be used for the detection of characters, figures, and logos. Shapes, geometries, sizes, or designs – the user can adjust the camera via the graphic programming interface to the respective task and environmental conditions in object detection. The robust and compact housing is constructed for industrial operating conditions. Apart from three freely programmable inputs plus one trigger input as well as three freely

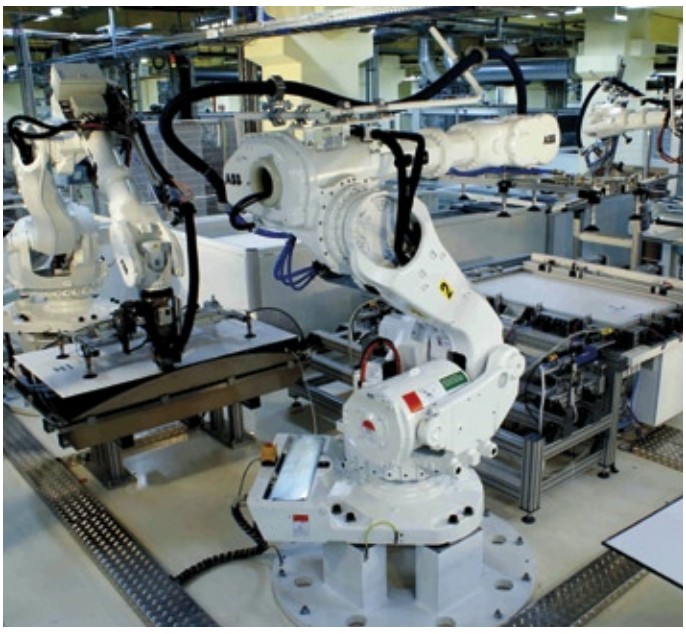
## About Conergy

Hamburg-based Conergy AG is one of the biggest suppliers of regenerative energy systems in Europe. Conergy develops, produces and markets all of the components necessary for the operation of solar power plants. It plans, finances, installs, and operates solar power systems in 15 countries on four continents. On top of that, the enterprise plans, finances and operates wind parks, bioenergy facilities as well as large-scale solar thermal power plants. Since being founded in 1998, the group has sold more than one gigawatt worth of renewable energy. In Frankfurt/Oder, Conergy built one of the most up-to-date production facilities for solar modules – with a fully integrated mass production from the wafer and the cell to the module.

programmable switching outputs, the IVC-2D features an Ethernet connection for fast and easy creation of a communication network. It can be used to transmit data and parameters to the machine controller easily. Apart from precision ABB Automation praised the simple programming, high immunity to ambient light and that the IVC-2D does not require any additional processor or computer support for operation.

### High Precision Edge Location

Every 100 seconds, one interconnected module leaves the robot work cell via a conveying system. In the next step of the process, a protective film made of EVA (ethylene vinyl acetate) as well as a weatherproof composite plastic foil are placed on the module. Afterwards, four modules per line pass through two laminators, where the solar glass, the cells, and the films are “baked” for approximately 17 minutes at 150 °C into a solid, weatherproof unit. Once these laminates have cooled to room temperature, a robot carries out the so-called edge trimming – the cutting of foil remnants projecting beyond the edge of the module. For this purpose, the robot takes the encapsulated solar mod-



Four robots cooperate to assemble the solar cells to modules

ule, puts it down, and measures, accurately to a few µm the edge positions using an OD MAX displacement sensor.

The OD MAX series includes high-precision distance sensors in four variants for operating distances from 24 to 26 mm, 25 to 35 mm, 65 to 105 mm and 250 to 450 mm. The CMOS sensors fit for quality control and precise position tasks due to the measuring accuracy of 0.1 % of the measuring range. The slightest changes in distance or height fluctuations are detected by the sensor reliably and accurately to the µm like the edges of the solar modules before removing the protruding remnants of foil.

The position data resulting from the precise measurement of the module's edge position by the OD MAX are used by the robot controller for guiding the cutting implements, ensuring exact trimming of the projecting foil remnants directly on the glass edge of the module. Accurate cutting is crucial for the quality of the solar module, since any damage of the foil would foster the penetration of moisture. In the penultimate process step, the solar modules are inserted into torsionally stiff and extremely weatherproof modular frames. In the last step, the module, almost ready for shipment, is fitted with a connecting box and undergoes testing for its performance data.

## Sensor Solutions from One Source

In order that automated manufacturing processes for solar cells, such as the ones at Conergy, reach a maximum amount of reliability and availability, the portfolio from Sick offers – apart from IVC-2D and OD MAX – additional sensor solutions. Examples therefore are optoelectronic, electromagnetic, as well as ultrasonic sensors in handling systems and solutions for identification of solar cell boxes, solar modules, or individual solar cells. Added to this are camera sensors such as Inspector, e.g. for inspecting edge fractures on solar cells, as well as solutions in machine vision for additional, diverse inspection tasks associated with solar cells. On top of that, electromechanical or optoelectronic safety systems – primarily the V300 WS camera sensor and a compact generation of light grids – provide for an optimum combination of safety, availability, and ergonomics, e.g. on partially automated work stations as well as on fully automated robot work cells.

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## Closed-loop Control Software for Blowmolder Management


Agr International announced a major breakthrough in the management of PET container blowmolding with the commercial introduction of its Process Pilot closed loop blowmolding control software. The Process Pilot control software is a real-time, process management program that works in conjunction with Agr's PETWall Profiler system to automate the management of blowmolder production. The Process Pilot program continuously monitors bottle material distribution data provided by the PETWall Profiler measurement system and automatically adjusts blowmolder settings to maintain optimal bottle distribution. "It essentially works as a 'bionic' operator," claims an early user of the system. "When the blowmolder is operating under the control of the Process Pilot software, the process is managed more effectively than with our best operator."

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

## Dutch Blonde Even More Attractive

The Grolsch brewery in the Netherlands relies on the expertise of two German companies who built them a machine with one simple goal – to sell more beer! The machine in question is not a mere beverage dispenser but a system relying on VisionPro from Cognex which uses special grippers to rotate and align the bottles so that they are in the best position with optimum visibility. The system operates with two parallel conveyor belts transporting up to 3,000 crates per hour through the bottle alignment machine, with each crate holding 16 swing-top bottles. Two industrial cameras are positioned approximately 1.5 m above the conveyor belts with each camera monitoring the five crates on its respective belt. The two cameras are intelligently embedded into homogenous area lighting units, which provide optimal illumination without casting undesirable shadows.

*Cognex France · Tel.: +33 1 4777 1550 · sales@cognex.fr · www.cognex.com*

## All Surface Front-end Inspection

Rudolph Technologies announced the sale of its Explorer Inspection Cluster to a major memory manufacturer in Taiwan. The Explorer is a new multi-surface inspection system designed to deliver fast, accurate and reliable macro defect inspection at a low cost of ownership. The Taiwan DRAM manufacturer has ordered the Explorer, total solution package' that includes the AXi940 front side inspection module, B30 backside inspection module, E30 edge inspection module, the Discover software package for inline defect analysis and data management, and TrueADC software for inline automatic defect classification. Rudolph's total solution not only can improve yields by performing high-speed automated inspection on the frontside of the wafer, but also is able to quickly identify edge and/or backside defects, such as cracks, chip-outs, delamination, residuals, particles and flaking.

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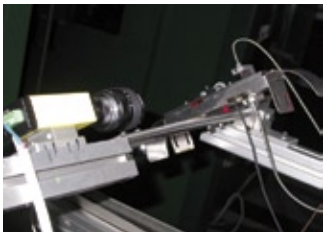
## Machine Vision Ensures Quality Control

Guangdong Tyco Electronics primarily manufactures connectors and cable assemblies. As the largest global manufacturer of electronic and electric components, Tyco Guangdong Electronics' high production yield of 1,000 of each set of equipment per day at a maximum of 1,200 pieces per minute makes on-line product inspection nearly impossible for the operator. For on-line product inspection, a random inspection was the primary solution; however, it generated a lot of waste and damaged equipment. This is why Tyco Guangdong Electronics introduced a Cognex vision system with the help of their trusted partner, Shanghai Ximing Vision Technology. Ximing chose the simple and well-developed Cognex In-Sight 5100 to guarantee consistent production. This inspection platform is equipped with the function of automatically saving the product picture, collecting flawed product data and displaying a size and trend chart of all products on the interface.



*Cognex Corporation · Tel.: +1 508 650 3000 · mktg@cognex.com · www.cognex.com*

# THE FUTURE STARTS NOW!


## GIT VERLAG is turning 40 ...

... and to celebrate this anniversary, we are publishing a special magazine, "GIT 40.0 – Initiative Zukunft (Future Initiative)". "GIT 40.0" takes a look into the future. Read our anniversary issue and find out what the next 40 years holds for journal readers, the future of trade fairs, the development of "Homo Zappiens" in our digital era and how we will be locking doors in 2049.

GIT 40.0 welcomes renowned authors including Prof. Hans-Jörg Bullinger (President of the Fraunhofer Society), Lothar Leonhard (CEO Ogilvy Germany), Sebastian Molewski (Chairman of Wikimedia), Dr. Stefan Groß-Selbeck (CEO Xing), Dr. Siegfried Quandt (President of the German Association of Technical Journalists) and Prof. Wim Veen (Technical University of Delft).

**A free e-version of this issue is available at www.gitverlag.com/40.html.**

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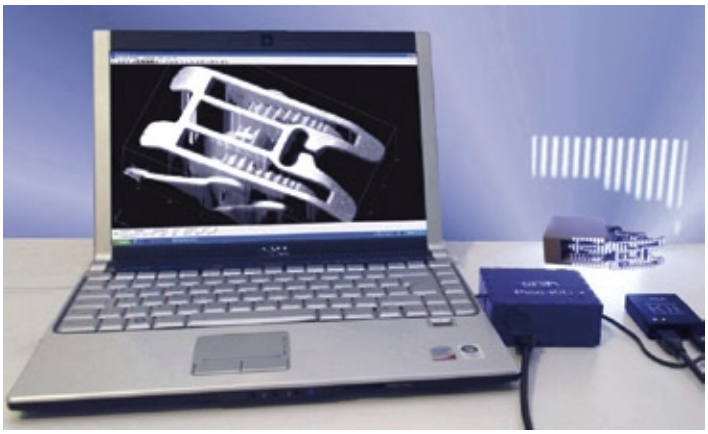
# Small, Smaller, Pico

## Industrial Metrology Makes Use of Pico Projectors as Optical 3D Sensors

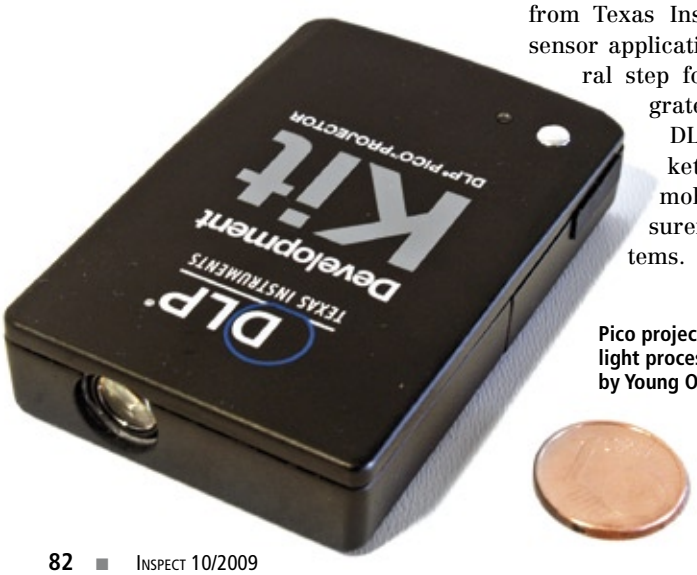

**Miniaturized light projectors, called pico projectors among experts, are used as optical 3D sensors for industrial metrology. They inspect the 3D structure of cutting-tools, e.g., or measure the interior decor surfaces of cars.**



**Pico DevKit with pico projector, a development platform for the digital light projection**

Today it is possible to watch movies on cell phones. Texas Instruments miniaturized the multimedia projectors in such a way that Samsung engineers were able to integrate them in mobile phones. The first cell phones with integrated pico projectors are already available for purchase. With this technology, customers can use the mobile devices for far more than just watching films. They can play self-made video sequences or present power point presentations using any wall or surface they want to. This shows how the communication technology pushes the miniaturization of systems to improve the performance parameters. This has become a demand also for optical 3D sensors in measurement and inspection systems. Only if small optical 3D sensors are made available, which provide easy handling at reliable accuracy and attractive pricing, optical 3D metrology will be able to acquire the position in technical applications that it has long been attributed to.

Since more than 10 years, measurement engineers successfully employ digital projection systems based on the DLP technology (Digital Light Processing) from Texas Instruments in optical 3D sensor applications. Thus it was a natural step for the company to integrate the miniaturized pico DLP projectors, so far marketed in connection with mobile phones, also in measurement and inspection systems.




**Pico projector based on the digital light processing technology as offered by Young Optics**

### Advantages of Pico Projectors

DLP projectors have quite a number of advantages compared to other technologies in measurement applications. Compared to the LCD based systems, light has not to be polarized which results in superior efficiency. The fill factor, the small distances between the micro mirrors at currently around 10x10 µm results in a homogenous image. Furthermore the images show a high linearity due to the digital pulse width modulation of the light. The high switching speed allows the 3D video acquisition in real time. All these advantages, originally developed for multi-media beamer or print system applications, are now applied to the new DLP based pico projectors as well. These projectors have exterior dimensions of approx. 70 x 50 x 15 mm and are weighing about 50 g. They can be connected to a PC via analog or digital interfaces, and can be operated just like conventional multi media projectors.

Optical 3D in-vivo skin measurement system PrimosPico

To make use of the projector as an optical 3D sensor it has to be connected to and synchronized with one or more acquisition cameras. For this task Texas Instruments developed a special circuit board, offered under the name Beagle Board, based on TI's OMAP3530.

This platform had originally been designed for small and energy saving systems such as smart phones and hand-held consoles. It comprises an ARM Cortex A8, a signal- as well as OpenGL-compatible 2D/3D graphics processor, and runs on Linux. Peripheral devices can be connected via USB. The HDMI connection between Beagle board und pico projector can transmit image data as well as control signals, allowing the setting of the projector's brightness and gamma parameters directly from the board. However, the required connection with the Beagle Board leads to a high entry barrier for digital light projection applications with the pico projector.

## Getting Over the Barrier with System Solution

Aiming at quick and efficient usability of the DLP pico projector's full potential, GFMesstechnik has developed the Pico DevKit, a turn-key solution for the easy adoption of optical 3D sensor technology as well as other applications of digital light projection. The scope of delivery for the Pico DevKit comprises the DLP pico projector, the Beagle board and necessary wiring, and can simply be connected to a standard PC via USB. The projector has been optimized for metrology applications by an especially modified firmware. The Pico DevKit provides programming interfaces for LabView as well as for Visual Studio and synchronizes external devices like cameras with additional trigger signals. The developer of digital optical light projection systems gets with the Pico DevKit a versatile tool, enabling him to implement applications without major additional development effort.

## Hand-held Measuring Devices

The picture above shows as one implementation example the hand guided optical 3D in-vivo skin measurement system PrimosPico for the acquisition and evaluation of human skin structure, wrinkles, wounds and scars, being used in cosmetic as well as dermatological studies world wide. Other applications realized with DLP pico projection in optical metrology, are 3D sensors for the integration in measuring machines, devices for the 3D measurement of body parts and faces, as well as hand-held sensors for industrial metrology, e.g. for the measurement of interior decor surfaces of cars, or for measurements on cutting tools.

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# Light Messages

## Electroluminescence Analysis Rises Quality of Thin-film Solar Cells



**Sensitive infrared cameras based on InGaAs detect weak electroluminescent radiation emitted by thin-film solar cells. These emit photons due to the external bias voltage and thus allow inference on the quality of the solar cells. So, micro fissures or the contamination of semiconductor layers can be inspected within a spatial resolution.**

Traditional solar cells based on silicon wafers have reached impressive maturity over the last 25 years. Compared to these not much is known about the thin-film solar cell's long-term behavior under various light and weather conditions yet. But thin-film solar cells have some essential advantages compared to the traditional cells. Current studies show that the energy yield of thin-film solar cells is significantly higher. Moreover they are about a factor 100 thinner than traditional cells. The size of only a few micrometers does more than saving weight. The cells can be integrated more easily in, e.g., roofing tiles, facades of buildings and glass domes. Among the materials currently used for thin-film cells are mono-crystalline silicon (Si), copper indium gallium diselenide (CIGS), or gallium-free CIS, as well as cadmium telluride (CdTe).

### The Effect of Electroluminescence

Solar cells base upon the photovoltaic effect: Radiation encountering the solar cells will be converted in electrical energy. Reversing this effect by applying an external bias voltage the cell emits light in form of electroluminescence (EL). This is because solar cells are composed of numerous pn-junctions parallel interconnected. Into these pn-junctions, the voltage injects electrons, which in part recombine with the available holes. The surplus energy exits as photons whose wavelength depends on the bandgap of the cell's absorber material. This bandgap energy covers the range between 0.9 and 1.7 eV which corresponds to a wavelength between 1.3 and 0.7 µm. Exactly in this range SWIR (short wavelength infra red) image sensors show their largest sensitivity. To cover even larger bandgaps and to enable parallel imaging in the visible and the IR areas, image sensors are tending to larger bandwidths: to VISWIR sensor arrays with a high spectral sensitivity at wavelengths between 0.4 and 1.7 µm.

The measured EL emission intensity of a solar cell reveals its quality. Details of mechanisms that could substantially diminish the power yield of a solar module can be detected, like micro fissures within the cell, parallel resistance effects or contamination of the semiconductor layers. Figure 1 shows a cross-section of a thin-film solar cell monolithically connected in series to the neighboring cell. Three critical areas are marked: P1, P2 and P3. In these areas humidity penetrated under the transparent and conductive oxide layers (TCO) and thereby diminished the cell's properties. In the area marked P1, there is a lowered parallel resistance. At P2, the ZnO/Mo contact corroded and at P3, the series resistance rises due to corrosion of the molybdenum layer.

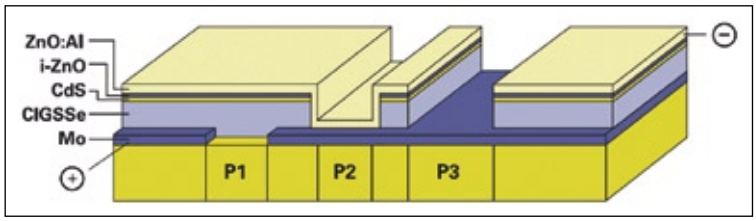



**Fig. 1: The areas P1, P2 and P3 of a monolithic series interconnection of two CIGS thin-film solar cells are endangered by corrosion**

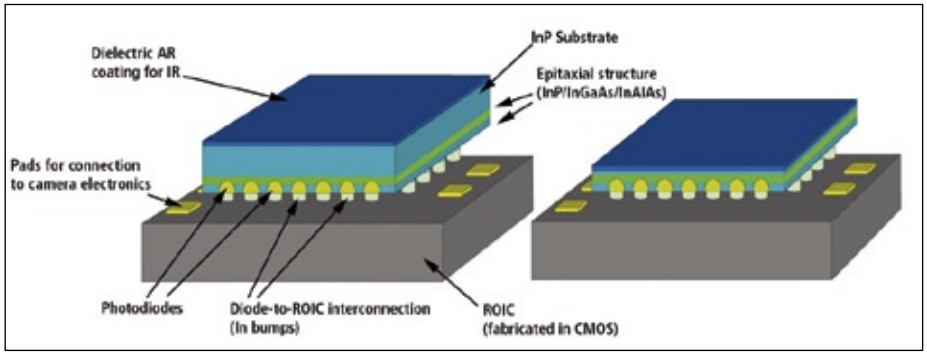
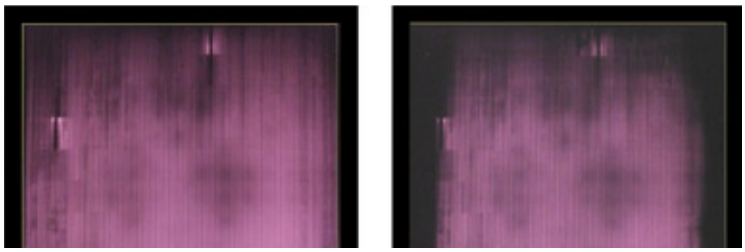



**Fig. 2: Thinning the substrate will turn an InGaAs SWIR imager (left) into a broadband VISWIR sensor (right) for thorough investigation of electroluminescence**

### Detecting the Electroluminescence

SWIR (Short Wavelength Infrared) sensors based on InGaAs (indium gallium arsenid) are sensitive to electroluminescence within a wavelength area of 0.9 to 1.7 µm. Figure 2 shows the design of the imager: The IR photodiode array is built on an InP epi-wafer substrate that is flip-chip mounted on a read-out integrated circuit (ROIC) in CMOS technology. The solar cell's exposure is then fashioned through the substrate. This however absorbs all light from the visible realm to 0.9 µm.



Source: Photovoltaik-Institut, Berlin, Germany

**Fig. 3: Missing electroluminescence radiation demonstrates the power loss in a solar cell (left) due to TCO corrosion after 1,000 hours of hot steam treatment (right)**

To prevent this loss of light, the substrate is thinned after the flip-chip mounting step: Additional layers of InGaAsP are inserted just below the photodiodes. They function as etch stops within the InP area. An HCL etch then selectively removes the InP epi-substrate exactly up to the InGaAs etch stop layer. This effectively thins the sensor chip down to just 5 µm (fig. 2, right), opening up the sensor to a broad wavelength coverage from 0.4 µm to 1.7 µm.

The weak electroluminescent emission poses high requirements on the measuring technique used. Accurate measurements will necessitate long integration times but the dark current of the image sensor is setting a limit. This influence can be reduced by employing low-noise sensors, as in the Xenics XEVA 1.7 320 camera, and by thermoelectric cooling of the sensor array. This will enable a 100-fold longer integration time and prevent weak local imperfections from getting unnoticed in the noise floor.

## Put into Practice

Figure 3 demonstrates the electroluminescent radiation in the near-infrared as captured by an SWIR camera. At the outset of a corrosion test (left) the module still radiated across the entire surface. After an extended hot-steam treatment over 1,000 hours, the sample suffered – obviously due to its sub-optimal mounting – substantial TCO corrosion along the edges (right). This halves the cell's power yield.

## Conclusion

Analyses of the weak electroluminescent emission given off by photovoltaic cells and modules not only ensure the quality in the cell's production. Also in development the given results support new findings and help to improve the thin-film technology. This will serve the overall goal of reducing the historical lead of traditional solar cells in favor of thin-film cells and developing novel power supply solutions based on the available solar energy.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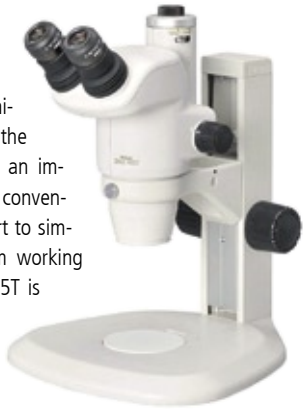
## Virtual Microscopy Made Real

Olympus has introduced its cutting-edge dotSlide 2.1 virtual microscopy system, offering advanced functionality with outstanding image quality. Available in three different models, this flexible and efficient system enables the virtual overview of an entire slide to be displayed in perfect quality on-screen. Furthermore, images are automatically saved in an online database where they are easily accessible for fast and secure remote image access. With excellent throughput for extensive image acquisition and superb documentation of tissue sections and tissue microarrays the dotSlide 2.1 system is ideal for all aspects of pathology and research. The dotSlide 2.1 system is based on the upright BX51 microscope, which ensures an outstanding optical performance. Furthermore, the peltier cooled dotSlide camera ensures high resolutions with fast frame rates and high sensitivity.

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

## New High Zoom Stereomicroscope



The SMZ745T trinocular stereomicroscope is a strong new addition to the Nikon stereo zoom microscope range. By optimising the design of the Greenough optical system, Nikon has realised an impressive 7.5x zoom, as well as incorporating a convenient optical path switch and built in camera port to simplify digital imaging. Together with a 115 mm working distance, this ensures the cost-effective SMZ745T is ideal for observation and digital image capture in industrial and biomedical applications. The high zoom magnification offers superb optical performance, while the zoom range of 0.67x to 5x provides a broad observation span. When the auxiliary objective lens and eyepiece lens are combined, the total magnification range is 3.35x to 300x. The adoption of a new total reflection prism has resulted in bright, high-contrast images.

*Nikon Instruments Europe · Tel.: +44 208 247 1718*
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## New Mantis Stereo Microscope with Inbuilt Camera

A stereo microscope from Vision Engineering is now available with a built-in, high resolution camera. The integration of a high performance camera will provide users with the advantage of effortlessly capturing images for reporting, cataloguing and communicating with colleagues and customers. The Mantis is a stereo microscope with patented technology allowing operators to inspect components in comfort. With an "eyepieceless" viewer, the Mantis Elite provides fatigue free viewing, optimising accuracy and productivity. Mantis provides up to x20 magnification with an interchangeable turret, providing operators with the versatility to switch between two objective lenses. Ideal for use when alternating between inspection and rework, operators can instantaneously switch between low and higher magnification, without putting the sample down.

*Vision Engineering Ltd.*
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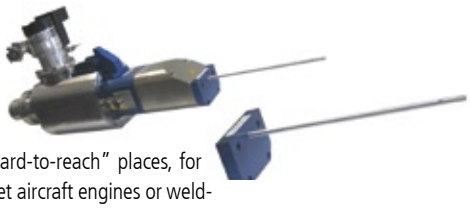
## Large Demand for Rod Anodes

Yxlon International is increasing its sales of standard rod anodes. Rod anodes from Yxlon supplement the high-performance microfocus X-ray tubes from the Feinfocus product family. The innovative, cutting-edge technologies incorporated into the anodes make them the ideal solution for testing materials at "hard-to-reach" places, for example when inspecting jet aircraft engines or welding seams inside pipes. These robust rod anodes are available as accessories for transmission target or direct-beam target tubes. A stable X-ray intensity is reliably assured by perfected mechanics. Above and beyond this, interchangeable targets possessing different beam characteristics ensure a wide-ranging field of deployment. The appropriate standard rod anodes for nearly any application can be delivered within the shortest time frame due to an extremely flexible modular building-block system based on years of experience in developing rod anodes.



*Yxlon International GmbH*
*Tel.: +49 5131 7098-85 · yxlon@hbg.yxlon.com · www.yxlon.com*

## Cooled 6 Mpixels Full Frame Camera

With the COOL-6000 VDS Vosskühler presents for the first time a cooled and high resolution full frame camera. The camera delivers 3072 (H) x 2048 (V) pixels, being digitized with 14 bit. By means of the large full frame sensor of the COOL-6000 a very high light sensitivity as well as a quantum efficiency up to the NIR range is being achieved. Owing to the high NIR sensitivity the fields of application of the camera are solar cell inspection and bioscience applications requiring long exposure times.

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## Inspection of Bearing Shell Presence

optoControl optical micrometers from Micro-Epsilon are being used during engine production at Volvo in Sweden. The sensors of the optoControl 1202 series measure the diameter of bearing caps and therefore automatically verify whether a bearing shell is present in the cap or not before being mounted by a robot. The bearing caps are transported on a workpiece carrier directly under the light band of the sensor. A robot picks up the bearing cap and lifts it so that the light band measures approx. 3 mm to the bottom edge of the bearing cap. The transmitter and receiver of the optoControl are mounted with a distance of 1,300 mm between them. The optoControl 1202-100 with a light bandwidth of 100 mm is used. The emitted light band is partially covered by the bearing cap. The size of the part is measured based on the shadowed light band.

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## Light Modulator Improves Images

With the linear and precise pure phase modulation the LCOS-SLM from Hamamatsu Photonics is optimized for high light utilization (90 %) and high diffraction efficiency. The X10468 LCOS series covers a wide spectral range from 355 nm to 1550 nm. The high light utilization efficiency mainly depends on reflectivity, and the amount of diffraction loss caused by the pixel structure. Hamamatsu adopted advanced CMOS technology to make diffraction loss smaller. As a result, the diffraction loss is less than 5 %. The modules with a dielectric mirror have a very high reflectivity. Therefore, these types offer very high total light utilization efficiency of about 90 %. Applications with high power lasers such as femtosecond Ti:Sa lasers become easily possible. On the other hand the broadband modules cover multi purpose applications from the visible up to the telecommunication wavelength band of 1,550 nm with the tradeoff of a lower light utilization efficiency of about 72 %.

*Hamamatsu Photonics Deutschland GmbH*
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## New Lightmanager and Nosepiece Encoder

Olympus has introduced the exciting new Lightmanager module for its BX41 and BX51 upright microscopes. The highly intuitive Olympus Lightmanager can be retrofitted and enables the user to set the desired illumination intensities for each objective and technique in use. This ensures more efficient control over objectives and illumination, providing excellent imaging results. It is an optional accessory that combines an advanced LED transmitted light source and a nosepiece sensor, which automatically senses the objective in use. LEDs provide a consistent colour temperature irrespective of intensity, removing the need for neutral density filters. As a result of this unique system, the optimum light intensity levels used for each objective in a nosepiece can be set for up to four different illumination methods.

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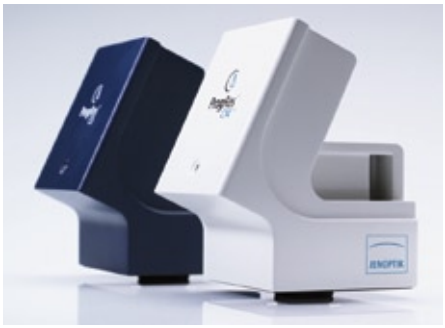
*www.microscopy.olympus.eu*

## Thermal Hyperspectral Imaging

Specim is expanding the range of available wavelengths for industrial hyperspectral imaging applications. The first Imspector imaging spectrographs and Spectral Cameras, i. e. imaging spectrometers working in MWIR (3–5 um) and LWIR (8–12 um) wavelength ranges have been delivered to sorting and quality control in different application fields. The possibility of using spectral imaging in thermal infrared region opens up new capabilities to apply hyperspectral chemical imaging to materials that cannot be classified, detected or inspected with systems working in the UV, visible or near-infrared wavelength ranges. In addition to the new instruments, Specim is also able to help customers with the selection of suitable cameras and illumination for different applications in thermal hyperspectral imaging. With the release and deliveries of these new devices, the company has become the first one providing standard hyperspectral imaging products for the full optical range from UV to LWIR in the whole world.

*Specim, Spectral Imaging Ltd.*
*Tel.: +358 10 4244 400*
*info@specim.fi · www.specim.fi*

## USB Interface Camera Line



A new product line with USB interface is added to the ProgRes Camera family and sets a new era. The new USB 2.0 based cameras in the ProgRes CMOS and CCD Research camera line were optimized according to customer wishes and have been presented expert public on Quality Expo in September in Rosemont, Illinois USA. The CMOS Camera models ProgRes CT1, CT3 and CT5 are now equipped with USB interface. With an extended resolution up to 5 Megapixel and a live frame rate up to 20 fps the new USB Camera of the CMOS Line delivers faster high resolution with excellent image results. New in the ProgRes CCD Research Series are the USB Models ProgRes CS and MS. These extraordinary and very sensitive cameras perform high sensitive imaging with up to 50 fps in full resolution (CCIR/PAL). One can also get the ProgRes CF and MF cameras now with USB interface with faster live imaging in SXGA resolution with 15 fps.

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# Visionary

## Interview with Dr. Savvas Chamberlain, Chairman of the Board, Dalsa Corporation

**INSPECT: Dr. Chamberlain, at Dalsa you've always put great emphasis on innovation. Looking back, what do you perceive as the most important innovations you brought to the market?**

**S. Chamberlain:** Looking back I see two significant early innovations which Dalsa brought into the market and put the company on the path to success. These are the high speed CCD image sensor line scan and the Time-Delay-and-Integration (TDI) CCD Image sensor.

High speed CCD line scan: The basic fundamental charge transfer theory for small geometry CCDs, which I developed with my graduate students in the 1970's and published in refereed scientific papers and text books, I transferred along with the know-how to Dalsa, and it was applied to produce the first CCD high speed line scan silicon imagers. These imagers could operate at 50 MHz while at that time the state of the art was 2–5 MHz maximum. The industry loved these devices. We became, and we still are, international leaders in this area. We now have CCD image sensors with an effective output pixel rate of more than 2.5 GHz.

Time-Delay-and-Integration (TDI) CCD Image sensor: With the CCD line scan image sensor, there are certain significant trade-offs. The customers need more speed, higher pixel count, higher spatial resolution and higher responsivity. All these requirements go against each other. The solution is the TDI. The TDI principle was invented during the Second World War and applied to improve the signal to noise ratio in radar detection of enemy aircraft. Quickly the principle works like this. During an integration time the signal is summed many times. By doing this, the signal strength increases proportionally with the summation number, but the noise increases with the square root of the summation number. Thus the signal to noise ratio improves with the summation. We applied this principle to realize an advanced line scan CCD image sensor. We used a CCD frame transfer architecture, and time delay and integration stages anywhere from 32 to 1024. Thus the signal was summed 32 times or 1024 times. By doing this we are able to provide high speed, high photosensitivity and high spatial resolution.

We started developing this technology at Dalsa in the early 1980's. In the research laboratory we could produce few devices at a time working very well but we had difficulty getting these devices to be predictable and repeatable. After about five years pursuing the development of these TDI devices in the Dalsa research laboratory, Brian Doody and I were asking ourselves whether it was time to recognize defeat and just give up. We decided at that time to give it more time and continue on the development. We successfully applied three dimensional computer device simulations and process fabrication simulations, and after seven years we were able to produce these TDI image sensors, predictably and with repeatable specifications. I am proud that I was the first to recognize the significance of the TDI technique and its application to high speed CCD TDI image sensors. I am also proud that Dalsa was the first to succeed in commercializing this technology.

**Following this strategy into the future, what are the challenges lying ahead requiring the next innovations in imaging technology?**

**S. Chamberlain:** I shall do a Greek dance before I come to the point of your question.

As the cost of computing is becoming cheaper and cheaper, the customers are able to handle higher and higher output pixel rate, are able to handle higher and higher pixel count, and of course, at the same time, they keep demanding that the spatial resolution and high photosensitivity is not sacrificed. Further to that, the customer wants the imager to be programmable and be adapted dynamically (on the fly) as the operating object and environmental conditions change. At the same time the customer does not want to pay more than what he pays now. So for us at Dalsa the challenge is to offer the customer improved performance without asking him to pay more, and at the same time we need to keep our gross margins to our present level. It is a difficult task, but we are confident that we can meet this challenge. Dalsa is well positioned to succeed. We have the scientific capital, more than 30 PhD's and more than 80 Masters in our research laboratories;

we have our own CCD sensor fabrication. We also have MEMS (micro electromechanical systems) technology which can be utilized in digital cameras. Dalsa will continue its strategy to offer technology innovation as a competitive resource.

**Today we see a lot of camera manufacturers active in machine vision. Do you expect a consolidation here during the next five years?**

**S. Chamberlain:** As the customers demand more and more sophisticated digital cameras, the associated technology of the digital camera, the sensor, digital hardware and the software, are all becoming more and more complex. To keep up with this, as a business, you need a certain critical mass in many and different areas. Smaller companies will not be able to keep up with this. I expect a lot of consolidation will happen during the next three to five years.

**You've just recently announced a transition into a non-executive role. Does that mean you will have more time for hiking and books?**

**S. Chamberlain:** I feel that there is time for everything. I am running out of time. Over the years at Dalsa I managed to surround myself with smart employees and smart executives. These executives are young, they have a lot of energy, they understand the technology, and they understand the markets and the customers. I am confident that our CEO Brian Doody can run Dalsa very successfully. I am not going away, as Chairman of the board I will still be involved at the board level.

I look forward to spending more time and travel with my wife, spend more time with my children and grandchildren, spend more time with my friends, listen to my music selections, look after my gardens, enjoy time on Lake Huron, enjoy nature, walking, hiking, concerts, opera theatre, as well as do some reading and writing.

**Dr. Chamberlain, we thank you for this interview and wish you all the best for the future.**

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## Preview

**Look ahead to our special on "World of 3D" and the following topics of our next issue:**

- Trade show review Vision 2009
- Basics of Machine Vision: Camera Calibration
- Time-of-Flight in Industry and Agriculture
- Illumination for 2D/3D machine vision
- Scanning in 3D and in 4D
- Real-time 3D reconstruction with GigE Vision
- Augmented Reality, 3D OCR and 3D Robot Vision
- Projected Fringes Technologies
- ROI Calculation for 3D Metrology

**This and much more can be found mid of November in the INSPECT 11/2009.**

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