VOLUME 11
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VISION ▸ AUTOMATION ▸ CONTROL

INSPECT

CUSTOM DEVELOPMENT

OEM CUSTOMERS

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Machine Vision Back to Growth

Future Trends for Vision Software

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www.dalsa.com/genie/i9/en

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Success and Constancy

"The secret of success is constancy to purpose," said Benjamin Disraeli, British Prime Minister and literary figure (1804–1881).

Constancy, an old word, out-of-fashion, more or less already excluded from our active vocabulary. Drive, Change, Flexibility. Aren't these the success factors that count today? In order to climb the corporate ladder successfully you need to move on to a new company every three to five years, is the advice you get from the relevant sources. Otherwise you'll become hard-to-place, as they say, boring, hence without success. To be successful at the stock exchange a company has to present new highlights to the financial world every quarter, only the dynamic is rewarded. The constant growth, the simple adherence to the own forecast, is here as well boring and will not raise the stock price above the average line. Also in sales the same mechanism is found. What counts is the new customer, the next business opportunity, the future project, the barely announced new product. These are the growth opportunities. The existing customer is not exciting, does not need to be taken care of. He is already there anyway. Thus, wherever you look, constancy has lost, is out-dated, obsolete, an antiquated concept.

Really? Let's have a closer look.

70–80 % of all European companies are run as family-owned businesses. Family-owned enterprises contribute at about 42 % to total company revenue in Germany und provide 57 % of all German jobs. One of the essential features of these companies and the entrepreneurs behind is constancy, often spanning many generations. This seems to be a cherished value again even for the next generation of family entrepreneurs. The German magazine "impulse," together with Zeppelin university and the Stiftung Familienunternehmen (Foundation Family-owned Enterprises), has recently asked 200 representatives of entrepreneurial progeny between 16 and 35 years of age about their values. Responsibility, trust, stability, hard work and ambition have been the highest ranked virtues. 97 % of the interviewees stated that selling the parents' company is out of the question, rapid success is only important for a small minority. Maybe this new generation of entrepreneurs will be setting a new trend, the renunciation of short-term success and the devotion to social responsibility and sustainability instead. For our economy this would be as healthy as it would be for our society. The environment would benefit as well. Benefits for the environment is by the way also the topic for this years' INSPECT expert panel at the Vision trade show in Stuttgart. Themed "Green Vision – Driving Factor for a Green Future" the event will have five internationally renowned experts present to the audience how they employ vision technologies in their products towards resource efficiency and environmental protection.

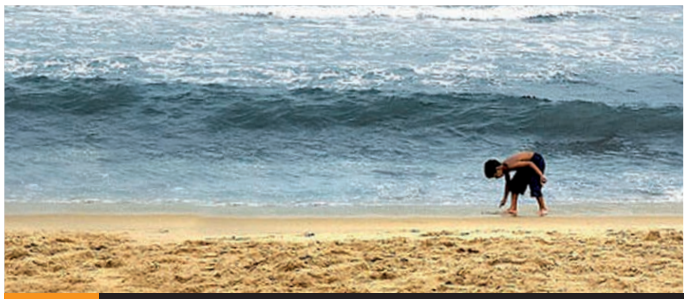
For INSPECT as for Disraeli success is reached with constancy in the goals. For us success is when we manage to provide you with up-to-date and comprehensive information, and entertain you with it. This is the goal that we set for every single issue of our magazine, every time. The fact that this September INSPECT celebrates its 10th anniversary might lead to the conclusion that we are not all that wrong with our goal and seem to be hitting the mark with the implementation. This success we owe to our many partners from industry and science who fuel us with top-notch data, work on cutting-edge topics with us, author high-quality articles exclusively for INSPECT, present their latest developments and learned insights at our events, and – this needs to be pointed out clearly – finance us with their ads. For all this cooperation we would like to thank our partners, we are happy and proud for their constancy over the last 10 years.

We strived to again provide useful information for you in this issue, and we hope that we will entertain you.

Gabriele Jansen
Publishing Director INSPECT

TOPICS

COVERSTORY



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How to Lose Weight … ▶ 48

TOPICS

VISION

VISION

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CONTROL

Strong 2010 First Half for Basler

Basler Vision Technologies has set an optimum course for future growth during the first half of 2010. In the second quarter of 2010, the camera business segment realized sales of € 10.7 million. The revenue increased by 91%, marking a new record level. On a global scale, the demand for digital cameras experienced positive development. Within the growth for all product segments, Gigabit Ethernet cameras continue to stand out. Basler was again able to increase GigE sales in the high double-digit percentage range compared to the previous year, which increased the market share even further. The new Basler ace GigE camera series introduced in November 2009 has been very positively received by the market. It has contributed to the sales growth for the first time and has ranked among the three best selling product lines in the second half of the reporting period.

www.baslerweb.com

Strategic Acquisition

Isra Vision completed the expected acquisition and acquired Graphikon, Gesellschaft für Bildverarbeitung und Computergraphik mbH, Berlin. The range of products from Graphikon represents a perfect supplement to the product offering of Isra for the solar industry. Graphikon is a well-known provider, particularly in the area of inspection of wafer-based solar cells as well as in the inspection of glass tubes. With the acquisition of Graphikon, Isra intends to increase the market penetration in the fast-growing market for renewable energy. The close sales and service network of Isra – with more than 20 subsidiaries worldwide – now also forms the platform for international sales and distribution of the solutions from Graphikon. The new Berlin location offers for the Isra group not only attractive future prospects through its proximity to research institutions and political decision makers in the German capital, but traditionally is also an important gate to the markets in Eastern Europe.

www.isravision.com

Success for MVTec in Patent Dispute

MVTec Software GmbH has announced that it has received an initial determination in its favor in the ongoing patent dispute raised by Cognex Corporation. The disputed Cognex patents all relate to matching technology. Following an eight-day hearing, the U.S. International Trade Commission (ITC) has ruled in its initial determination that all of the patents are invalid. Because the ITC found the patents invalid, Halcon will continue to be sold and imported into the USA. „MVTec certainly respects intellectual property rights – up to the point where they turn out to be based on questionable patents," says Dr. Olaf Munkelt, MVTec's managing director. „We will continue to defend ourselves as well as our customers against any complaints that we believe are without any merit," he adds. Based on its initial determination, the ITC will make a final determination on this case in November 2010.

www.mvtec.com

New Alicona Subsidiary in France

With its new French subsidiary, Alicona continues its steady growth. Next to France, the supplier of high resolution optical measurement runs offices in Germany, UK, USA and Asia. "In France we particularly notice an increased number of inquiries for measurement solutions that can be applied in both, research and development as well as in production. Production integrated quality assurance becomes more and more important," states Alicona CEO Stefan Scherer. The new office is directed by Pierre Prolland, an experienced expert in metrology and long-time partner of Alicona in France.

www.alicona.com

NEWS

Representative Office in Japan

Industrial camera manufacturer IDS Imaging Development Systems GmbH has opened a representative office in Tokyo, from where Christian van der Ploeg is providing assistance to distributors and customers in the Asia-Pacific region since June 1, 2010. About three years after expanding into the west, the new motto is "Go East!" Since mid 2007 the company from Obersulm in Swabia, Southern Germany, has been operating a wholly-owned subsidiary in Boston, which is now well accepted in the market. The new representative office in Japan is intended to increase the level of support available to the company's trading partners in the APAC region.

www.ids-imaging.de

Stemmer Imaging Finishes Positive Fiscal Year

Stemmer Imaging, Europe's largest imaging technology provider, has finished the 2009/10 financial year on June 30, 2010 with overall sales of € 35.7 million. This meets the target set for the financial year. The 2009/10 financial year has seen difficult conditions due to the international economic crises, so it is extremely pleasing that Stemmer Imaging was able to come through this period without any consequences for personnel such as reduced working hours or redundancies. By keeping the full workforce of more than 130 employees and therefore guaranteeing no loss of expertise, the company is well set for the emerging recovery in international markets.

www.stemmer-imaging.com

Micro-Epsilon Systems Technology Division Expands

This summer, the System Technology division of Micro-Epsilon has moved into larger premises. With a floor area of 1,300m², this provides the System Technology division with sufficient space for six large offices and a good-sized assembly area. Micro-Epsilon's System Technology concentrates on seven different sectors, whereby process control of production and quality assurance processes are always the focal point. In addition to the automotive and tyres/rubber sectors, the sheet metal, film extrusion, aerospace and defence, glass and semiconductors industries are also supported with special measurement and inspection systems. Today, the Systems group comprises three locations with specific core competences. Austrian company Atensor in Steyr is involved with robotics. In particular, this division is concerned with automatic track generation for robot-automated production of small batch sizes based on the dimensional measurement of the object to be machined. Settled in the automotive sector with core competences in dimensional measurement technology of tyres and rubber production, the company ME-Inspection SK whose head office is in Pressburg, Slovakia, also belongs to the Systems group. The System Technology business area of the Micro-Epsilon Group has approximately 40 employees in total across its three sites.

www.micro-epsilon.com

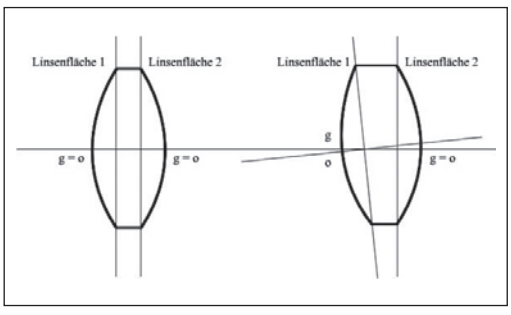
Tracing Deviations

USB 2.0 Camera Detects Centering Errors of Optical Lenses

Optical lenses with centering errors do not necessarily have to be rejected as long as the exact deviation between the optical and the geometrical axis is known precisely. So far instruments with focus lenses and collimator are used for these tasks. However, the handling of these instruments is cumbersome if the type of lens often changes. Now, lens manufacturers are offered an alternative: a new centering tester with USB 2.0 camera.

Due to mechanical manufacturing steps like beveling, polishing, centering and coating, the fabrication of optical lenses is complex and often leads to so-called centering errors. Centering errors indicate the deviation of the optical axis from the geometrical axis and are due to defects in manufacturing while processing the boundary of a lens. The geometrical axis (g in fig. 1) is the axis of symmetry of the cylindrical lens boundary, while the optical axis (o in fig. 1) of lenses with spherical surfaces, for example, results from a line through both centers of curvature of the spherical lens surface areas.

The exact determination of the axis' deviation can avoid the lenses' rejection. Up to now, instruments which use a suitable focus lens and a collimator – a device that narrows a beam – and focus a reticle on the center of curvature of the test surface, are widely used. The handling of these gauges can be a disadvantage if the type of lens often changes. That's why Schneider-Kreuznach looked for a solution with a higher precision and better handling and developed a gauge based on the reflection method.



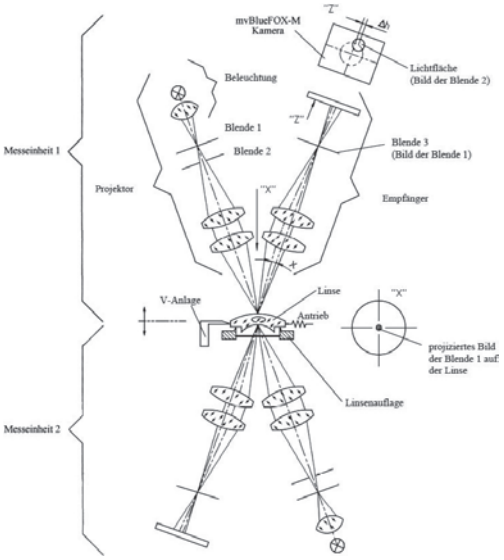
Optical and geometrical axes and their deviation

The Reflection Method

In the first step of the method the lens to be measured is mounted on the lens adapter and a drive mechanism turns the lens. An illumination device, containing light source and lens, lights the aperture 1 (fig. 2). The projection lens focuses the aperture 1 on the reflecting surface of the test piece. From there, the reflected light beam will arrive at the optical receiver which focuses the image of aperture 1 into aperture 3. Behind aperture 1 in the direction of the light, there is aperture 2. This aperture is wider than the first aperture. Behind aperture 3 in the direction of the light, an image sensor is positioned in such a way that the camera sensor is located in the plane of a real image of aperture 2. In the next step, the shift on the camera sensor of the center of energy in the image of aperture 2 is measured while the lens is turning. If a centering error exists on the surface of

Technical Data of the Centering Tester VP30508

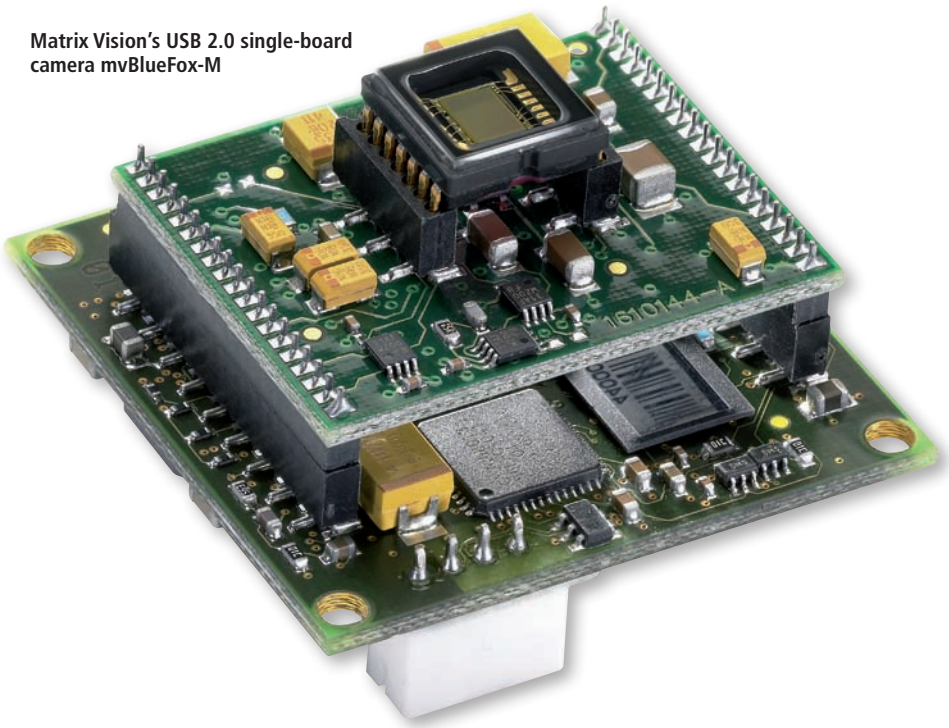
- Precision 0.01 angular minutes
- ISO Standard 10110
- Lens diameter 5–200 mm
- Radius of curvature >= 5 mm
- Min. lens center thickness 0.4 mm
- Min. residual reflectance > 0.05% at 635 nm
- Lens glass or plastic
- Suction on request (vacuum)



Optical principle of the centering tester based on a reflection model. The centering tester from Schneider-Kreuznach features a second measuring unit

(Diagram courtesy of Schneider-Kreuznach)

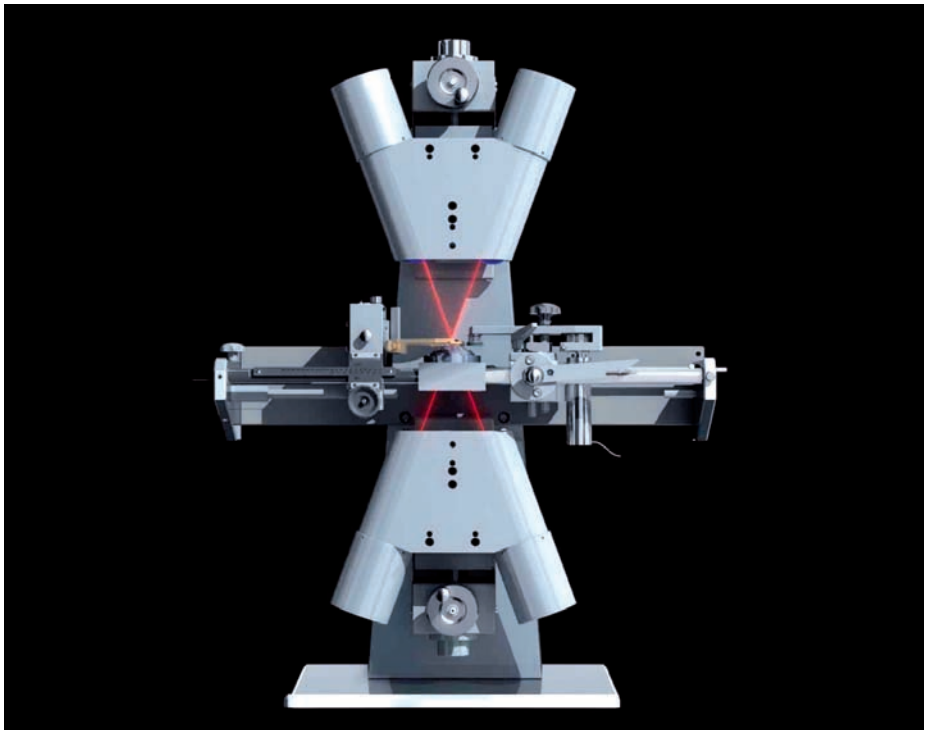
Matrix Vision's USB 2.0 single-board camera mvBlueFox-M



the test piece compared to the rotation axis of the lens, the light spot will move on the camera sensor.

Optimizing the Gauge

The first generation of the centering tester was based on a conventional camera/frame grabber solution. To simplify the latest generation of instruments, however, the latter should give way to a solution using a digital USB camera. To keep the basic design of the device Schneider-Kreuznach needed a small, flexible solution with high image quality and found the Matrix Vision's single-board model of the mvBlueFox camera. With a length and width of only 38.8 mm and a maximum height of 34 mm, the module fitted the given profile. Not only does this camera have an additional image memory of 8 MByte for buffered image transfer, the quality of its very low-noise images also convinced.



Centering tester VP30508 from Schneider-Kreuznach

A Dream Team

The instrument and camera form a perfect team which, with a precision of 0.01 angular minutes, meets the highest demands. Centering errors are measured according to ISO 10110 without the need to know any lens data (radius, focal length, etc.) as others methods do. In combination with aperture 3 as an effective spatial filter, the alignment of projector and receiver with an angle of ±20° makes it possible to get a high separation effect during probing of the optical surface. It is also possible to measure lenses with a center thickness of 0.4 mm without any problems. Given that the tester is equipped with two measuring heads, two mvBlueFox-M modules are used. Therefore, lenses with two lens surfaces can be measured on both sides without the need to turn the lens over.

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Machine Vision in Europe Returns to Growth

Most European Vision Companies Unharmed by the Crisis Year

The financial and economic crisis of 2009 had severe effects on the European machine vision industry. However, the results of the European Vision Technology Market Statistics 2010, the annual market survey conducted by the European Machine Vision Association EMVA, point to a positive development of turnover with European machine vision products in 2010.

Industrial production still accounts for the biggest part of the recorded turnover with machine vision systems and components out of Europe. However, the so-called non-industrial applications continue to rise in importance. Vision applications more and more conquer areas such as safety and security, health care, market research, as well as environmental technologies, sports and electronic entertainment. At the same time, the integration of machine vision into machinery will continue, up to a point where the technology becomes a core part of the machine and is no longer a mere add-on to it.

While inspection remains the largest application area of machine vision technology, 3D metrology is the big winner in applications in 2009. The trend towards 3D is supported by new developments of manufacturers of cameras as well as smart cameras and providers of machine vision software.

Significant Sales Collapse in 2009

The recorded sales volume of the European market study reached almost € 738.6 million in 2009, a decline of 21.4% compared to the year before. 72.6% of the total sales were realized within Europe. Sales to Germany – the largest market for machine vision products in Europe – declined by 23.7%, while the decrease of supplies to Italy was somewhat smaller with 19.7%. Sales to the United Kingdom and Ireland went down by 12.5%, and also France saw a relatively moderate decrease in turnover of 12.1%. The only countries in Europe that saw an increase in absolute sales have been Spain and Portugal, here turnover increased by 4.8% compared to 2008. Exports to the Americas decreased by 24.2%, and thus above average. Compared to this, the business with Asia was more robust: Turnover with all customers in Asia declined by 18.8%. Here, exports to Taiwan and Japan were hit most, while sales to South Korea even managed to increase by 14% (see fig. 1). Overall, exports to overseas accounted for 27.3% of the total turnover.

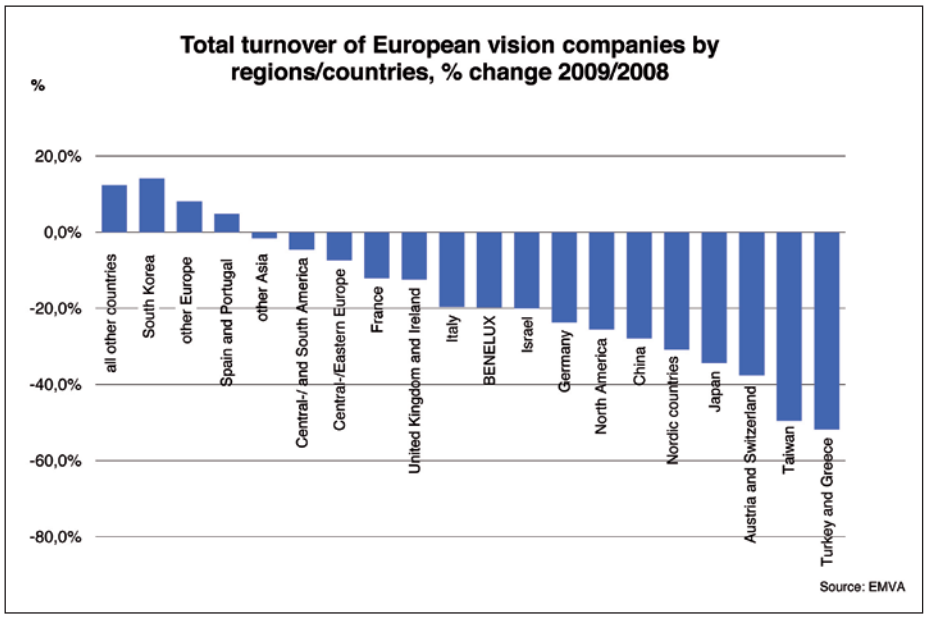
Sales of vision systems accounted for 51.6% of the total turnover, and turnover with vision components had a 43.7% share in 2009. The overall decrease of total turnover in 2009 is distributed almost equally amongst the two product categories: sales of all vision systems declined by 22.1% in 2009, and turnover with vision components decreased by 21.4%. All product types were deeply affected by

© DG Jones/flickr.com

EMVA Market Study

The „European Vision Technology Market Statistics" is an annual industry study issued by the European Machine Vision Association (EMVA). Data from 205 companies in the European machine vision industry have been evaluated for the 2010 edition of this report. Data for the report has been primarily collected directly from the companies in a questionnaire-based survey, complemented by numerous interviews with experts across Europe.

Industry sales in the survey are broken down to regions, product types, applications, and customer industries. In addition to the European statistics, readers now find three country-specific reports covering machine vision in Germany, Italy and – for the first time – in the United Kingdom. The survey does not only address enterprises in the machine vision industry, it can also serve as a valuable tool for stakeholders from all industry related areas who wish to find out more about the market, trends and developments. The 2010 study can be obtained directly from the EMVA.

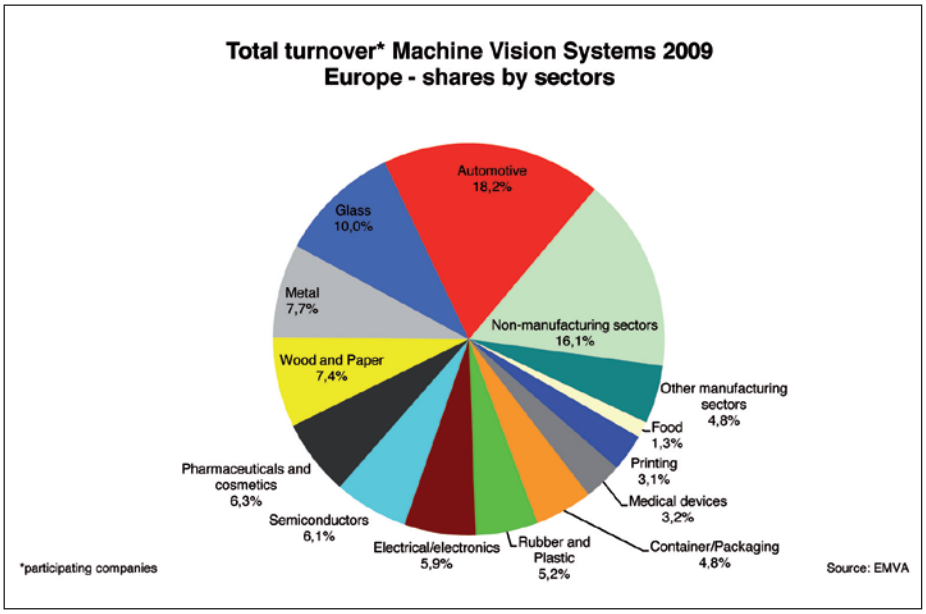


the crisis. The decrease ranged between 10.6% for other vision accessories and 33.6% for smart cameras. Among the vision systems, configurable systems proved to be the most resilient to the economic downturn, however also they saw a double-digit decrease in sales by 14.5%. Recorded sales of application-specific vision systems – which have the highest share of total turnover with 37.5% – decreased by 22.3% or in absolute numbers from € 356.9 million in 2008 to € 277.3 million in 2009. Sales of cameras – the second largest product type in terms of turnover with a share of 28.1% in 2009 – went down by 20.5%, or from € 261.3 million in 2008 to € 207.8 million last year.

Vision Companies Managed to Keep Their Staff

Overall, machine vision companies in Europe have reduced their personnel underproportionally to the decline of turnover in 2009. The industry characterized by small and medium sized companies is rather independent from short-term shareholder-value pressure, and growth strategies focus more on the medium- and long term success. Furthermore, the companies are well aware of the costs that occur for training new people when the economy picks up again.

On average, in 2009, the companies in Europe employed 29 people, with a peak in Germany: here the average vision company employed 32 people. Italian companies are below the European average, on average they have 16 employees on board. British vision companies are even smaller: their staff size is at eight employees on average. With 86%, the vast majority of machine vision enterprises in Europe employed less than 50 people in 2009. Almost every second machine vision company in Europe has ten employees or fewer and can be counted as a small enterprise.

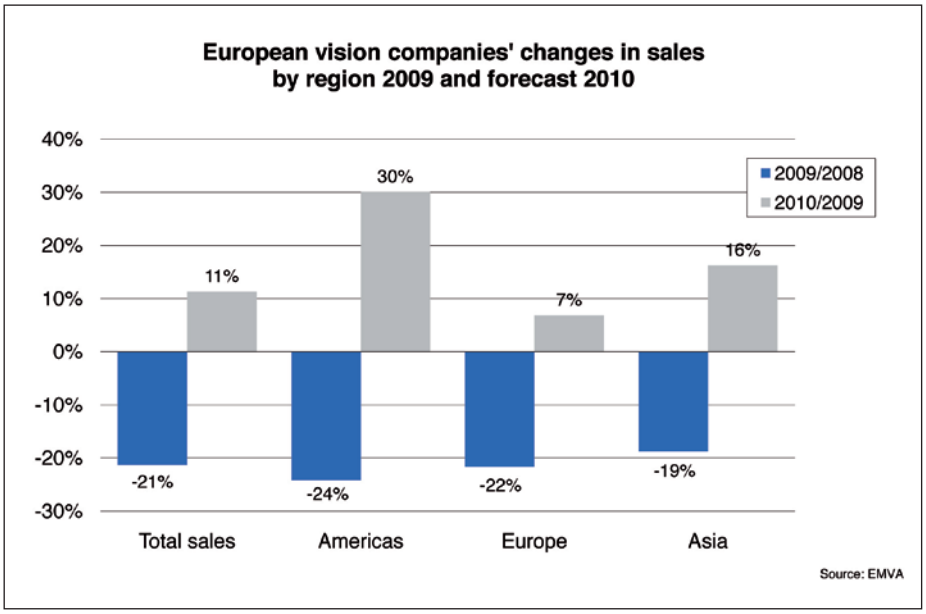


Turnover Increase in Non-manufacturing Sector

Never before has the distribution of total turnover share of the different customer industries been as balanced as in 2009. Three sectors had a double-digit total turnover share: The automotive industry (18.2%), the non-manufacturing industries (16.1%), and the glass industry (10%). Another six industry sectors range between a 5% to 10% share of total turnover, namely the metal industry, the wood and paper industry, the pharmaceutical and cosmetics industry, the semiconductors industry, the electrical/electronics industry, and the rubber and plastics industry (see fig. 2). This development goes mainly at the expense of the automotive industry, as this key industry was severely hit by the financial and economic crisis, and machine vision sales into it declined by 35.3% in 2009. Combined, all manufacturing sectors closed with a minus of 27.6% in 2009, while the non-manufacturing sector increased turnover by 29.4%. The non-manufacturing sector now accounts for 16.1% (2008: 9.7%). This is quite a remarkable shift that underlines the large growth potential of non-manufacturing applications in the future.

3D Metrology Gains Ground

Among the applications of European vision technology, inspection is still by far the main one. Together, inspection of discrete parts and inspection of webbed material made up a share of 50.3% of total turnover by all vision applications in 2009, down from 61.9% in 2008. With 32%, the inspection of discrete parts was again by far the most important application of machine vision technology, but saw a huge decline in the crisis year. The lower demand in customer industries that produce end consumer products such as automobiles had a huge impact here. On the other hand, continuous inspection managed to gain some share of total turnover and increased from 17% in 2008 to 18.3% in 2009. The largest increase of total turnover was seen in 3D metrology. Here the share grew from 10% to 15.8% in 2009. This trend is expected to continue since the still relatively new 3D technology is about to conquer new application fields. Guidance, character recognition and symbol reading are other applications that managed to gain some share of total turnover in 2009, whereas 2D metrology and part recognition lost some ground.



11% Growth Expected for 2010

Clearly, 2009 has been the most difficult year ever for the European machine vision industry. However, industrial imaging remains a vital component in the automation business, and European suppliers are amongst the leaders in providing machine vision technology. Thus, it is likely that business recovers again. In addition, clear signs for a recovery of the world economy have been on the horizon since the end of 2009. This is supported by a key indicator to the machine vision industry: The worldwide turnover of machinery sales is forecast to grow by 9% in 2010. This points to a favorable business climate in the traditional industrial application areas of machine vision. Positive signals also come from almost all other customer industries. Overall, total turnover of machine vision in Europe is expected to increase by 11% in 2010, with the markets in the Americas and Asia being the main drivers (see fig. 3).

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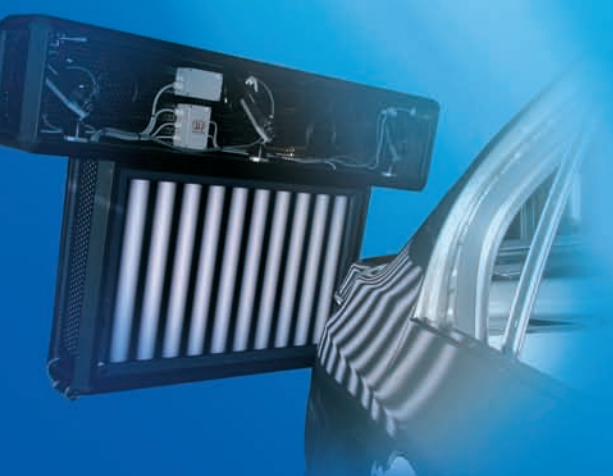

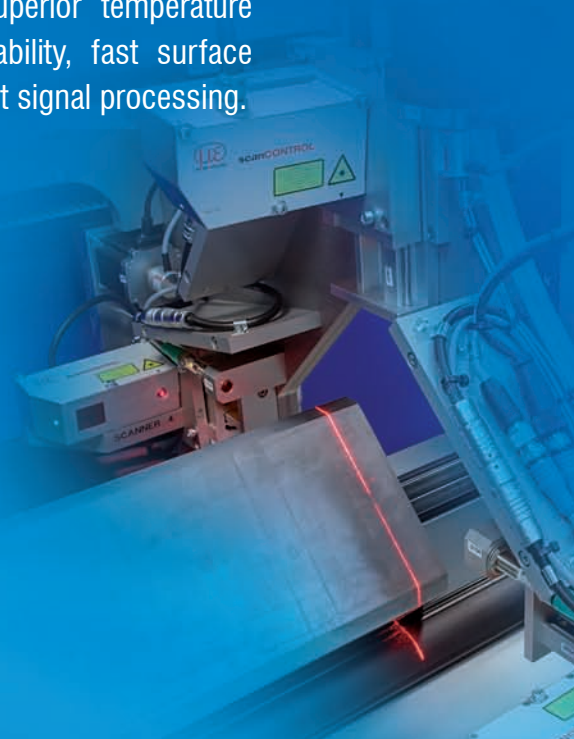

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10 Years of INSPECT

A Decade of Highlights in Machine Vision and Optical Metrology

10 years ago, in September of 2000, the first issue of INSPECT was published – humbly, as a special edition of the MessTec & Automation magazine.

Meanwhile our baby has matured into a successful independent European journal, published six times per year in German and six times per year in English language for 35,000 recipients and many more readers. The magazine is complemented with a German/ English web site and the annual European Buyers Guide. For us, this is clearly a highlight.

We have asked our readers what has been a highlight for them in the last ten years of image processing, machine vision and optical metrology – from their own personal point of view. This is a small sample from the feedback we've received.

Not only machine vision has advanced significantly over the last 10 years. Also the INSPECT was striking new paths and has become one of the most important magazines for our public relations. The Baumer team congratulates to 10 years of exciting, innovative and informative reporting on the highest level. We wish you all the best and are looking forward to a good cooperation in the future.

Jens Klattenhoff, Head of Sales & Marketing, Baumer Optronic, Germany

My personal highlight of the past 10 years has been the miniaturization of the vision technology. What has been a bulky set-up 10 years ago today fits (almost) into your shirt pocket. This helped to open up new fields for machine vision, even in the non-industrial sectors.

Oliver Barz, Senior Technical Sales, Edmund Optics, Germany

In product identification and product handling, our "seeing" robots are measured against human capabilities. This is a huge challenge considering that the "natural" perception is one of the most complex developments in sensual organs. However, we gladly accept this challenge and put it into practice for more than 25 years now at continuous development and improvement.

Dr. A. Nasraoui, Research and Development Manager, Gerhard Schubert Packaging Machines, Germany

10 years of INSPECT are also 10 years of boom in optical metrology in a range of different markets. For PI this has been a time of double digit growth and a fast-paced development especially in the area of nano-positioning devices. Nano technology in the sense of increasing miniaturization of functional structures has become suited for the industrial needs. People having attended this development during the last 10 years are looking back with amazement and eagerly into the future ahead!

Sandra Ebler, Marketing Assistant, Physik Instrumente (PI), Germany

Happy birthday!

Dr. Anwar Shahbaz, Abdul Rashid Enterprises Packaging & Paper, Pakistan

For us the smart camera has been the most important development, since it offers the optimum price/ performance ratio at this time.

Peter Wolff, Head of Development, Espera Werke, Germany

First of all, we would like to tell you that your magazine is as enthralling as a thriller regarding the topicality in machine vision. I am working with Datalogic for more than 20 years now. Our company is very much coined by optical identification but always also involved with RFID, a topic very much in discussion over the years. At the end of the day, both are identification technologies complementing each other. Over the period of the last 10 years the focus continuously shifted into the direction of machine vision, i.e. from laser scanner to camera scanner or image processing, due to the above average increase of Data Matrix Code (2D code). This development is covered well in your magazine, one reason why we are always looking forward to the next issue of INSPECT.

Bernhard Lenk, Business Development & Certification, Datalogic Automation, Italy/ Germany

The content of your magazine is well balanced with plenty of 'solid' information. Keep up the good work and a very happy birthday!

Ignazio Piacentini, CEO, ImagingLab, Italy

A highlight of the last 10 years of image processing and machine vision is certainly the strong penetration of these technologies into most segments of the manufacturing industry and beyond.

Marc Damhaut, Senior Vice President Product Management & Associate General Manager, Euresys, Belgium

Dr. Wolfgang Eckstein, CEO MVTec Software, Germany

As one of the leading magazines for imaging and optical metrology, the INSPECT celebrates its 10th anniversary. MVTec sincerely congratulates the entire team of INSPECT on this great success! Also out of our view as a manufacturer of machine vision standard software, the last 10 years were eventful. Machine vision became a true multi-purpose technology also beyond the typical markets. Due to sophisticated algorithms, this technology now has conquered the third dimension. Meanwhile, the machine vision industry passed its fledgling stage. By this, several international standards have been released which today give customers a better protection of investment and the freedom of choice of components. Despite the market decline in 2009, the turnover of the machine vision industry has doubled during the last 10 years. Even in the year of depression, the industry remained healthy and could widely avoid dismissals. At the moment, indeed the stormy growth of the beginnings has slowed down; nevertheless, machine vision also will follow a growth curve in the oncoming years due to new application fields as there are traffic engineering, medical sciences or sports and consumer markets. Surely, INSPECT will keep us well-informed about this development also in the future.

First of all, I would like to congratulate on the first decade of INSPECT. I have been reading the English issue and receiving the German issue only for two years. I read it as a scientific journal, and find it useful. I think you improve the quality and contents profile.

Prof. Dr. Osman Adiguzel, Firat University Elazig, Turkey

I believe that human lives for something more interesting than stay along the conveyer and doing visual inspection, manual assembling or sorting. It has to be replaced with some machines not only because of economical reasons but in purpose to allow the human spent his or her life in a more intellect-intensive way. And machine vision is the key component here. In spite of last decade's progress in computing, digital cameras and communication – some piece of art is in every machine vision application. And probably therefore passion and professionalism are recognized within the machine vision community more often than elsewhere in automation. I'm personally glad to be part of this trend for the last decade and hope to be there for the next one as well.

Maxim Soroka, CEO, Vitec, Russia

We wish INSPECT all the best for this milestone birthday and are looking forward to the news from our industry we will learn about from INSPECT during the next 10 years. One of our highlights during this past "INSPECT Decade" has been the development of a fully automated system that combines metrology and automation for the purpose of inspecting highly flexible piston rings. Our customer was able to benefit from a significant cost reduction through the use of this machine.

Uwe J. Keller, Marketing Manager, Dr. Heinrich Schneider Messtechnik, Germany

The Laser industry experienced a rapid development during the last 10 years. Our very individual highlight during that time has been the invention of the Laser product family ZM18. One Laser type for all kinds of applications – from simple positioning via machine vision up to highly precise scientific uses – was unheard of up until then. We would like to cordially congratulate INSPECT and all team members on the 10th anniversary and thank you for the good and successful cooperation!

Anna Pfefferle, Marketing Manager, Z-Laser Optoelektronik, Germany

Congratulations on your 10 year anniversary!

Jonathan Barnthouse, Account Executive, Pentax Imaging, USA

We would simply like to thank you for your articles. We develop and build complete test systems for a diverse range of industries, "turn-key" as you say. Through inspirations from your editorial work and the presentation of new products we were able to improve our systems. The articles are of high quality and enlightening, the presentation of new products is of utmost importance to us.

Heinz Panzer, Managing Director, L&_P Elektroautomatisation, Germany

For me, the highlight is that machine vision managed to evolve from a fascinating idea where a great deal of convincing had to be done with every single application into a key technology nobody wants to live without any longer still creatively opening up new fields of applications. In the Powertrain area at Daimler the population increased from some 30 machine vision systems in 2000 up to over 400 systems today.

Claus Lörcher, Production and Material Engineering, Team Acoustic and Optical Inspection, Daimler, Germany

Being the inventors of the Laser tracker, the rapid advancement of this technology is our highlight of the last 10 years. Laser trackers are today the probably most versatile measuring instruments you can find on the market. They are portable and widely weatherproof. Moreover, they are very precise and well suited for static and dynamic use – and this for really large measurement fields. Happy birthday to INSPECT for the 10th anniversary and all the best for the next 10 years!

Marc Keinert, General Manager Europe, API, Germany

Most noteworthy from the last decade are the advances in computing power (i.e., from low-power CPUs to multi-core CPUs, GPUs and FPGAs), device integration (i.e., the smart camera) and flexible/robust algorithms (e.g., geometric pattern recognition), which partially owe their existence to the increased computing power at our disposal.

François Bertrand, Vice President Sales & Marketing, Matrox Imaging, Canada

Machine vision has advanced significantly over the last 10 years. Just a few years ago, vision systems were difficult to implement, had limited applicability and often required a custom designed solution. Today, highly complex machine vision applications are easily realized using off-the-shelf solutions. The machine vision industry and its customers are benefiting greatly from this improved maturity and sophistication. Not only are traditional applications seeing better solutions at lower cost; but, new markets are being enabled and developed. The future of machine vision has never been brighter with expanding applications driving the growth of the industry. Baumer is leading this growth and is well positioned with technical accomplishments and products that meet the international market's sophisticated requirements for today's and tomorrow's customers.

Dr. Oliver Vietze, CEO & Chairman, Baumer Group, Switzerland

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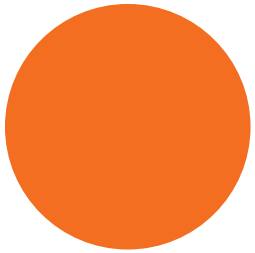

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Congratulations to the entire INSPECT team on an outstanding trade journal that distinguishes itself both in content and in design very positively and that has evolved into a very strong position on the market. VMT has worked with INSPECT right from the beginning with issue #1 and would like to thank INSPECT for the cooperation of these many years. VMT was founded in 1995 by Harald Mikeska and Dr. Frank Grünewald and is today part of the powerful Pepperl + Fuchs group of companies. Today the company employs a staff of over 50 people at six locations in Germany, USA, China and Spain – and expansion is continuing.

Joachim Köhler, Press and Media Coordinator, VMT, Germany

Katrin Vogel, Marketing Communication, Kappa, Germany

One highlight? The technology-driven innovative market with its enormous growth potential produces highlights every day. Hardly another industry today has experienced such a dynamic development and there is no end in sight. Image processing is expanding at record speed, boosted by the progress in cross-sectional technologies like computer and sensor technology. What was yesterday an exotic specialization is already turned into affordable large-scale standard production today. Customers can choose from a broad range of components and solutions, but might sometimes get lost in the megapixel race and in the jungle of interfaces. The INSPECT gives a clear view of this multi-faceted industry landscape with qualified information. Thank you!

I would say that the biggest highlight for me was the confirmation that there is always room for improvement. I always thought that we had the best inspection equipment because who we were.
Advances in CPU speeds, optics, and lighting has shown us that not because our customer is not pointing out the defects that you are shipping means that we are doing fine. New technology has giving us the advantage of finding small imperfections in our product before they become a defect.
New Vision Technology makes you strive to be better.

César Montiel, Principal Engineer, Anheuser-Busch InBev Packaging Group, USA

visicontrol celebrates its 20th anniversary this year. During the first decade machine vision evolved out of its infancy in production and quality control and learned to walk, guided by integrators and system solution providers. The second decade brought on wild teenage years, opening up new perspectives in the industry through the advance of vision sensors and powerful vision algorithms boosted by increased computing performance. We are looking forward to shaping the next 20 years. It will stay exciting – and INSPECT will keep us up-to-date.

Dr. Albert Schmidt, Managing Director, visicontrol, Germany

Machine Vision is a technology with very diverse, exciting fields of application. I am especially fascinated by the trend to migrate vision tasks directly into the camera which only a couple of years ago still required a PC. Highly integrated smart cameras are today able to solve even complex tasks completely autonomous. The trend towards increasingly compact, lightweight and energy efficient modules will open up many new application areas to put machine vision to good economic use.

Oliver Menken, Sales & Marketing, VRmagic, Germany

I've found the highlight in the years 2000 to 2010 to be the migration of image processing from complex and expensive special technology for factory applications to cost-efficient, easy-to-integrate mainstream applications in the industrial, medical, entertainment, and consumer goods sectors. In my opinion, the main factors driving this trend are based on the increase in performance in processors and cameras and also on the decreasing prices for image processing components and solutions. Compact size and ease of use are other important contributors to the trend.

Dr. Dietmar Ley, CEO, Basler Vision Technologies, Germany

Best Players play at VISION

The international who's who of the machine vision industry meets year after year in Stuttgart. The world market leaders will be there, in addition to many small, highly specialised companies. They will present their systems, components and services, as well as applications for various sectors: from the automotive industry to mechanical engineering, from the food industry to medical technology.

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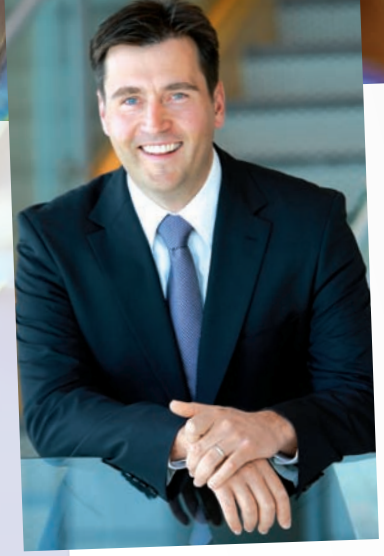
VISION 2010

23rd International Trade Fair for Machine Vision

Messe Stuttgart, 9 – 11 November 2010

Looking back at the last 10 years, one particular highlight in the field of machine vision has been the rise of intelligent cameras. Ten years ago, they were considered a niche product – now they are standard components in a wide range of industrial applications and increasingly replace PC-based image processing systems. Vision Components has contributed to this development, and I am very proud of that.

Jan-Erik Schmitt, Vice President of Sales, Vision Components, Germany



A decade ago there were a few large camera manufacturers and several smaller ones, and differentiation between them was primarily based on interface, which at the time was mostly Analog, FireWire, Camera Link, or USB 2.0. Prices were also much higher, making total vision system costs difficult for some end users to justify. Ten years later, there are even more vendors, and many of the smaller ones have grown to be much larger players. They no longer differentiate based solely on interface, have broadened their image sensor options, and dropped their prices significantly. This has contributed significantly to opening up new markets and applications we could not have imagined 10 years ago.

Vlad Tucakov, Director Sales & Marketing, Point Grey Research, Canada

In 2001, it was not easy and as well not low priced to set up a high resolution digital 4-camera system. Only to assemble a 10 m cable with four military Airborn 100-pin connectors took a lot of patience, hard work and calm hands for the soldering – or about € 1,500 for the assembled cable set. All together the cameras, a 32-Bit frame grabber and the cables have been sold by Rauscher 10 years ago for over € 15,000 to OEMs. Today 2010 – in the era of GigE Vision – the costs for the cabling are just about € 40, a frame grabber is not necessary anymore and the price for the camera is much lower. Additionally, our customers are happy with the simplification and the advantages of the GigE Vision solution.

These new interfaces are certainly one highlight of the last decade of machine vision. Rauscher played a leading role in the introduction and the propagation of this new technology.

Ernst Rauscher, Managing Director, Rauscher, Germany

I sincerely congratulate on the 10-years anniversary of your INSPECT magazine. INSPECT is „the" source of information for machine vision.
There have been many highlights during the last 10 years, impressive developments along the whole process chain of image processing: illumination, optics, cameras, computation architecture, and vision software.
I would like to put special emphasis on smart cameras and the enormous performance increase of CCD and CMOS cameras. These developments have enabled machine vision to become a valuable and indispensable tool in automation technology. By the use of machine vision on the factory floor productivity and quality have been improved significantly.
Your magazine, INSPECT, has provided an essential contribution to this development. It is the mix of competent technical articles, also by company representatives, the wealth of information about new developments, as well as the articles covering the machine vision basics, what makes your magazine so valuable for the machine vision user.
Important tasks for the future years are the further technological developments of vision components, standardization, reusability of once developed vision solutions, benchmarks of vision algorithms, robustness of vision solutions, and the ease-of-use of vision applications.
The cooperation with research institutes and universities on one hand and industry on the other needs to be further cultivated and intensified so that research understands what industry needs, but also to enable a faster transfer from research results into real-world applications. I see focal points for development in the area of "learning image processing" for defect detection and in the robust, precise and fast 3D object detection for the automation of visual inspection and the process control in production.

Walter Happold, Central Sector Research and Advance Development, Bosch, Germany

Calendar

DATE	TOPIC · DETAILS
13.09.–16.09.2010 Stuttgart, Germany	**Microsys** Trade Fair for Micro and Nano Technology www.microsys-messe.de
05.10.–08.10.2010 Essen, Germany	**Security Essen 2010** The World Forum for Security and Fire Prevention www.security-essen.de
27.10.–29.10.2010 Bilbao, Spain	**QA&Test** 9th International Conference on Software QA and Testing on Embedded Systems www.qatest.org
27.10.–29.10.2010 Beijing, China	**Vision China 2010** China International Machine Vision Exhibition and Machine Vision Technology & Application Conference www.visionchinashow.net
09.11.–11.11.2010 Stuttgart, Germany	**Vision** International Trade Fair for Machine Vision www.vision-messe.de
09.11.–12.11.2010 Munich, Germany	**Electronica** International Trade Fair for Components, Systems, Applications www.electronica.de
21.03.–24.03.2011 Chicago, IL, USA	**Automate** International Robots, Vision & Motion Control Show www.promatshow.com

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

Machine Vision in Iran

Market Situation, Entry Barriers and Opportunities from an Inside Perspective

While the development and use of machine vision is a well-researched topic in Iranian academic circles, it remains relatively unknown for the majority of Iranian industries. In October, the "6th Iranian Conference on Machine Vision and Image Processing" will be held in Isfahan. However, with machine vision, just as with other technologies in Iran, there is virtually no interaction between the academic and industrial sectors. This is one of many reasons why machine vision still has a way to go to become a standard component of Iranian manufacturing processes.

Machine Vision Landscape in Iran

Although machine vision systems can be found in some plants, most of them were imported as part of machinery such as, e.g., German or Italian blister-packaging machines in the pharmaceutical industry with an integrated machine vision based inspection system, or food packaging machines with embedded machine vision.

Some Japanese machine vision components producers such as Omron and Keyence are active in Iran through their distributors. However, the distributors are mostly focused on those companies' industrial automation components rather than on machine vision, and their machine vision sales are not significant.

As for domestic integrators and designers of machine vision systems that are presenting solutions for the industry, there are perhaps three or four companies. Among those, Kasra Hooshmand Engineering (KDI) is the most active Iranian company in the field of machine vision. KDI designs and develops machine vision based solutions for virtually all industries.

In the fields of traffic monitoring and number plate recognition applications, there are, however, additional companies both private and government-owned.

Although few Iranian corporations are as focused on machine vision as KDI, the contribution to the global machine vision industry of Iranians abroad is considerable. One of the most well known examples is Amir Novini, President of Applied Vision (Ohio, USA) and long time member of the Board of Directors of the AIA (Automated Imaging Association). Majid Mirmehdi is another internationally-acclaimed Iranian machine vision expert who was Chairman of the British Machine Vision Association from 2005 to 2008.

▲ Representatives of different nations under the Persian Empire are bringing machine vision cameras among other gifts for the Persian emperor in Persepolis

Barriers for Machine Vision

With the biggest steel, car, ceramic tile and vegetable oil industries in the Middle East, with more than 60 pharmaceutical companies and food, beverage and detergent production industries leading in the region, Iran has the potential to be one of the biggest importers of machine vision components in Asia.

About Iran

Iran is a country in Western Asia and is bordered by Armenia, Azerbaijan, Turkmenistan, Afghanistan, Iraq, and Turkey. The name Iran is a cognate of Aryan, and means „Land of the Aryans." The first unification of Aryan people (Mede, Persian and Parthian people) in Iran occurred in 625 BC in Median Empire. Their successors, the Achaemenid Empire, founded by Cyrus the Great in 550 BC, established the largest empire in ancient history and the first World Empire. The current population of Iran is about 74 million and the total area of the country is 1,648,195 km². Iran has large reserves of petroleum and natural gas and is one of the biggest economies of Western Asia and the Middle East.

The biggest problems in the way of achieving the aforementioned goal can be summarized in three points:

- Most managers in the industrial sector are not aware of the benefits of machine vision systems. This problem can be solved only by an intensive and intelligent marketing campaign by machine vision companies. KDI has made a great effort in the last couple of years to educate these industries about machine vision and how they can benefit from this technology. Nevertheless, one company cannot reach everybody. A combination of both domestic and international companies is needed to penetrate this vast market and to familiarize industrial managers with the machine vision potential.
- The lower cost of labor in Iran in comparison to Europe and North America makes it harder to convince industry owners to replace a human-based inspection system with a machine vision system. This situation often inhibits sales of machine vision systems because the task can be done inexpensively by local workers. However, KDI has been successful to sell machines that do simple human tasks – such as counting the number of items inside boxes – to large and successful manufacturing entities.
- The third and the biggest problem is the governing system of the country. A high level of corruption, coupled with a low level of technical knowledge within the upper managerial levels in the governmental organizations responsible for controlling the quality of products, cause manufacturers to simply bribe government agents instead of improving their production facilities. Thus, the quality inspection sections of factories, which are the biggest customers of machine vision systems, become the main victims. Furthermore, due to this lack of technical knowledge, governmental agencies often do not enforce some internationally well-accepted and enforced standards. These include the very strict FDA and GMP regulations for the pharmaceutical industry which often motivate manufacturers to buy machine vision inspection systems to ensure the quality of their products. The government also owns the majority of the manufacturing sector as well as some crucial monopolies such as the automotive industry and, of course, the oil and gas sectors. In reality, the government owns large portions of all of Iran's larger industries. Generally in governmental monopolies, attention to quality of products is the least important matter, because they can easily sell whatever they produce due to lack of domestic competition and very high import taxes for foreign products which can compete with the government built products such as automotive products.

About KDI

Kasra Hooshmand Engineering Co. (KDI) was established in 2003 with its office located in Tehran, Iran. The company's field of activities are design and development of machine vision systems, industrial automation, PC-based automation and monitoring, LabView programming and microcontroller-based systems. KDI also has a section for design and installation of cleanrooms. KDI is the industry leader of machine vision and real-time image processing-based inspection and control systems in Iran.

Tempting Market

With all these discouraging facts, there is still hope for machine vision companies. There are several privately-owned manufacturing firms in Iran. They compete with each other to present better products to Iranian consumers and to conquer the markets of neighboring countries. This healthy competition has made them eager to improve their production facilities, and that's where machine vision comes in. We, as a company as well as an industry, need to teach them what machine vision can do for them and we need to do it with persistence and the belief that we can succeed in this market.

Considering the three problems outlined above and keeping in mind that this market of US$ 859 billion GDP (PPP) has many opportunities to offer, machine vision companies should consider Iran a very tempting yet not an easy market. Only those with sufficient patience and targeted marketing strategies can benefit from this market and reap the financial rewards.

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Vision in Sight

Vision 2010: Leading Global Trade Fair with Attractive Supporting Program

"All key players are back on board," says Messe Stuttgart at the Press Conference for Vision 2010. The international trade fair for machine vision takes place at the Stuttgart Trade Fair Center from November, 9 till November, 11 and is deemed to be the industry's leading show. It is set on a growth path and shows its importance long before the show starts.

This year, Vision takes place for the 23rd time. Over the years, the trade fair has developed into an essential international information and presentation platform for the machine vision industry. With the new claim "International Trade Fair for Machine Vision" Messe Stuttgart places emphasis on the trade fair's importance also for non-industrial applications.

In these days, many user sectors of industrial image processing announce good news: from the mechanical engineering and plant engineering, plastics and rubber engineering, as well as from the robotics and the electronics industry. The increasing incoming orders in these branches are also reflected in the development of Vision 2010. Numerous exhibitors have already booked. Until the beginning of the trade fair, Messe Stuttgart expects an exhibitor number which will exceed for the first time ever the 300 mark. All key players are back on board, also those who took a break during the crisis year of 2009. Some of the companies even decided to increase their booth sizes. For the first time there will be an international pavilion. There, 10 international companies who have up to now not been represented at Vision, have the opportunity to present their innovations.

Twice as many exhibitors as previous year will attend the Integration Area this year. This area is sponsored by the trade journal INSPECT and gives the system integrators the opportunity to present their specific applications.

Attractive Supporting Program

This year again, an exciting and practice-oriented framework program awaits the trade show visitors. One example is the traditional Industrial Vision Days organized by the VDMA Machine Vision, which provides quality information to exhibitors and visitors through specialist presentations on all three trade fair days.

Thomas Walter, Manager for Industry & Technology at Messe Stuttgart, reports that he expects more than 6,000 visitors on all three days

The lectures feature state-of-the-art technology, discuss standardisation efforts and provide innovative and practical solutions. Once again, a particular highlight will be the expert panel, organized by the trade journal INSPECT. The innovative theme of „Green Vision – Driving Factor for a Green Future" will be the topic addressed on the second day of the trade fair from 2 p.m. to 3 p.m. Five renowned experts will present to the audience how vision technologies help to protect our environment, support economical use of resources, improve energy efficiency, play a role in the development of eco-friendly products and overall pave the way for a "greener" future.

Furthermore, Messe Stuttgart presents the 18th Vision Award to a company selected by an international jury for their innovative idea and practice-oriented new development. Besides there are seminars for machine vision beginners, a job board informs on current job offers and this year for the first time, a career center coaches engineers and scientists on their career opportunities.

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Vision China 2010

Machine Vision Trade Fair in the Growth Country China

From October, 27 till October, 29, the China International Exhibition Center Group (CIEC) invites to the machine vision trade fair in Beijing, China. The trade show takes place in the China International Exhibition Center; co-organizer is the CSIG, China Society of Image and Graphics. The China International Machine Vision, short Vision China, is held for the 7th time in 2010. There, more than 100 exhibitors from home and abroad show machine vision components like smart cameras, illumination, software solutions, boards, lenses and other equipment as well as system solutions. The fair's focus is not only to inform the predominantly Chinese visitors on the latest products and technologies, it is also to provide a branch platform for the machine vision companies. They can exchange ideas, negotiate partnerships and improve the machine vision market in China with their know-how.

Parallel Events

At the same time there is an application conference. There are covered the topics like 3D machine vision or the color machine vision technology as well as current trends in Chinese machine vision. And of course, experts will hold lessons on vision solutions in several fields like the contactless quality assurance, security or intelligent traffic applications. In the year 2009, more than 6,000 visitors attended both events, trade fair and conference. This year the organizers expect significantly more visitors than last year, because China's demand on machine vision solution grows unhindered. In addition to the Vision China and the application conference, there is on the ground of the trade fair also the 15th China International Lasers, Optoelectronics and Photonics Exhibition. Interested visitors can combine the attendance of both shows.

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No Martini, No Party

Image Processing Basics: Illumination

We are at the end of the first decade of the 21st century, the "century of the photon." Machine vision is an accepted technology on the factory floor in virtually all manufacturing industries and in a number of important non-industrial areas. But where are the groundbreaking innovations, the spectacular developments, the awesome achievements leading into new, unheard-of regions of knowledge and business?

In the past 10 years, we neither saw the equivalent of the landing on the moon nor of the flight over the Atlantic Ocean, and the invention of the Laser celebrated its already 50th anniversary this year. Instead of picking a single highlight, this article focuses upon a continuous development within the last decade, which seems to be quite unspectacular at first sight: the growing awareness of the fundamental relevance of lighting for machine vision.

No Illumination, No Machine Vision

An image processing system is bound to process only those features of a scene which are somehow illuminated. This statement seems to be trivial and represents by no means a new finding. A novelty, however, is the fact that everybody working in this field nowadays will be confronted with this piece of inevitable truth. As early as 1991, Hartmut Ernst in his excellent textbook [1] covers lighting in an own chapter, although on only three out of about 300 pages. A key passage reads as follows: "An important component for image processing is application-specific lighting. A good lighting of the scene to be captured often allows the use of simpler and thus faster algorithms for the evaluation of the image. In general, lighting will be optimized to achieve high contrast. Usually, minimizing shadows and reflections will also be called for." This advice is as important and proper today as it has been 20 years ago. Lighting should be used to enhance features of interest and to suppress unwanted structures. In this sense, lighting is a necessary and quite efficient step in image processing. Lighting by ambient light from natural sources will nowadays only be accepted when no alternative is available.

Further Development

Over decades, machine vision was primarily treated as "digital image processing" in most textbooks, putting emphasis on the algorithmic handling of the image data file. Filters, grey-level transformations and morphological methods where described in great detail. Even in 2005 a book on image processing [2], without any doubt one of the best in the field for introductory purposes, treated illumination in only one scarce sentence: "The actual process of image formation is often complicated and usually insignificant for image processing". On the other hand, in the same year the 6th edition of a standard-textbook [3] already featured main aspects of the interaction of lighting and objects on 35 (out of 600) pages. A textbook published in 2008 [4] takes great care to emphasise the importance of lighting as a system component for machine vision applications and dedicates a full chapter with 12 of about 300 pages to the topic, presenting valuable hints

and examples. And this year a major distributor of machine vision components has published a voluminous catalogue with about 300 pages [5], putting 20 pages in an application note and further 40 pages in product information on lighting technology, that is about 20% of the total volume. Here you may find the remarkable comment: "The choice of the proper lighting is crucial for the quality of the image acquisition and can strongly simplify the subsequent evaluation of the image. Often, however, the significance of the proper light source for an image processing system is underestimated. Finding the appropriate lighting is a demanding task".

What's the Problem?

Lighting – just a piece of cake? Light is a concept of human visual perception. Electromagnetic waves with wavelengths between about 400 nm and 700 nm are a sensory stimulus for our eyes and brain. For us, it is a matter of course to experience the brightness and chromaticity of our natural environment on a sunny day through our eyes. We may even read a newspaper at night in the desert with just the moon shining above, although the light intensity is several orders of magnitude lower than at noon on a clear summer day. Even at much lower light levels we can navigate and define objects, and many of us are not even aware of the fact that our color vision vanishes under these circumstances and "all cats are grey" in the night. Shadows and inhomogenities in our field of view usually will not significantly affect our ability to interpret the scenes in our natural environment. Even the tremendous variations of the spectral distribution of the natural light from the sun during the day does not catch our eyes, and we will see the white plastered facade of a house as a white surface, whether it is illuminated by the romantic red of a sunset or by the white sunlight at noon. The layman usually never will realize the tremendous pattern recognition performance of the human visual system. Only few professionals like photographers or interior decorators develop an intuition for these problems. Even senior machine vision systems engineers may be amazed when they become aware of the facts. The abilities of our human visual system seem trivial for us, and we instinctively expect the same performance from a technical system, tempting us to underestimate the relevance of lighting for machine vision applications.

A Professional Approach

Ten years ago, only few companies specialized in lighting equipment for image processing. Meanwhile, every trade fair in the field offers a broad spectrum of such products. Notably, several companies with a strong background in high-end optics joined this business, utilizing their competence in optical engineering and complementing their product range with LED-lighting-devices. Lighting nowadays is recognized as a profitable segment of the machine vision market and treated as a demanding engineering

task. In fact, the essential development during the last decade happened in our mind, since "the innovative manufacturers of machine vision systems became aware of the significance of lighting …" [6]. It is not by sheer coincidence that at the same time non-imaging optics became an additional feature in several professional tools for optical design. Lighting concepts for sports arenas or automobile head lights are nowadays designed and optimized with ray-tracing-tools. These methods can seamlessly be adapted to lighting systems for machine vision. Micro-optical heads for laser-diodes, e.g., provide structured lighting with defined circular, point- or line-patterns. LEDs with their compact form factor and their compatibility with standard electronics open up completely new concepts, which can only be exploited with optical design tools. For line-scan cameras, e.g., LED-line-lighting devices are available with programmable intensity profile. In addition, the long lifetime and the defined time structure of emission are important advantages for industrial applications. Even UV-lighting with LEDs is possible nowadays. The most important technical development within the last decade, however, is the general availability of sufficiently bright white LEDs. Shuji Nakamura, who basically invented these devices in 1993, was honoured for this with the Millennium Technology Prize in 2006 [7].

The Future

While light, strictly speaking, is limited to the region of human visual perception, the Silicon- and InGaAs-detectors of our standard-cameras are sensitive up into the near IR. In the upcoming years, the spectral distribution of lighting and the spectral regions beyond the visible range will receive more and more attention. The color rendering index of light-sources already is an important feature in color image processing, and several applications use NIR-imaging within the sensitivity range of Silicon-detectors. Light sources with programmable spectral distribution are already commercially available, and people become aware of the fact that spectral discrimination is not restricted to dispersive devices at the detector but may also be achieved by lighting. Spectacular leaps in technological development, however, are not to be expected. Believe it or not, innovation is a slow process. Even when triggered by enlightenment.

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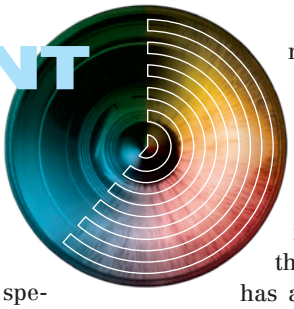
VIEWPOINT

10 Years of INSPECT: Yesterday, Today and Way Ahead



In the year 1984, I had initiated a special editorial series titled „Optical Systems for Construction, Development and Manufacturing“ for a well-known professional journal for construction. Thus I am in the lucky position of having been able to experience and accompany the development of industrially-oriented image processing almost from the very beginning. In my first comment on this topic, I wrote: „Today, the interaction of the technological findings concerning optical systems, electronics, computer science and microprocessor technology permits us to enter into the age of visual communication and of visually automated machine control and -handling. Technological developments have a life of their own and can not be held back.“

That is a statement which could be repeated today.

My boldest expectations of that time were, however, exceeded by far through reality. If I had predicted at that time, what is today regarded as a common, everyday application, then I would have even categorized myself as a boundless dreamer. The „minicomputers“ used at that time were, after all, in the size of a small table, the cameras were quite voluminous, and the efforts required for programming were complex and intricate.

Nowadays, the efficiency of those systems would only evoke an indulgent smile.

All technological core segments of image processing – optical systems, electronics, computer science and microprocessor technology – have experienced gigantic evolutionary leaps. The interaction of this progress has led to an enormously dynamic development with regard to innovations across the whole bandwidth of industrial image processing.

More than 10 years ago, image processing was exclusively restricted to PC-supported systems. It has now been approximately 10 years, since the first compact and autonomously functioning so-called vision sensors have entered the market. At that time, the heated but technically sound debate about this topic was already to be found in the newest edition of INSPECT. The efficiency of these IP-systems has increased so rapidly within the past 10 years that they have assumed many of the tasks of PC-supported systems. The vocabulary used takes this into account by the fact that the „vision sensors“ are now only referred to as vision systems. Hardly five years have passed, since a new performance category of miniaturized systems has established itself, which are now labeled as vision sensors. And today, we are at the verge of another new generation of miniaturized systems in image processing. Parallel to this rapid development, INSPECT has again and again distinguished itself by the fact that it not only had the function of a communication platform for top-notch quality assurance, it also had the ambition to direct the quality of communication towards the requirements of today.

If I should dare to make a forecast regarding the situation in 10 years from now, then I begin to ponder the present explosion regarding performance in all technologies involved in image processing. This will have profound effects in all industrial and non-industrial areas, and in our daily lives as well.

The outcome of extremely effective image processing, in direct combination with a brilliantly conceived control scheme, may already be seen in all walks of life. It is the dream come true for every design engineer involved in image processing. Everything is miniaturized in the greatest extent possible. Extremely fast image capture and transmission of the image information in real time, extremely efficient functioning of algorithms in complex image analysis, fast learning ability in reaction to changed parameters, precise determination of the position and orientation within the changing 3D-space, direct and extremely efficient interaction of image analysis and control functions in the mutually shared processor to direct or command movements. Almost as if everything were on a single chip. And all that is integrated in the heads of insects, such as flies or dragon-flies, measuring only a few millimeters.

Each one of these unique functional modules could, however, also stand synonymously for the dynamic course of development in image processing. This applies for the whole bandwidth of new research projects and developments, with all the fast-track progress they are making. Is the prediction therefore presumptuous or arrogant, that we will be using highly efficient „insect heads“ everywhere within the next 10 years, if the framework conditions remain as they are?

Kamillo Weiss
Independent Editor

A Smoother Pebble…

Cognex's Bill Silver on the Future Developments in Machine Vision

One of the outstanding visionaries of our industry is without doubt Cognex co-founder and Senior Vice President Bill Silver. By getting him away for a short time from both, programming (which he still does daily) as well as ultimate Frisbee (which he still does daily also), INSPECT was able to obtain some of his insights on the future developments and challenges in machine vision.

INSPECT: What would you name the most important development in machine vision software during the last decade?

B. Silver: The machine vision industry seems to be well past the stage where any one software development could be called the most important of the decade. In the 1980's one could point to Cognex's Search (normalized correlation) or Itran's GUI, and in the 1990's PatMax, but for the last decade it's much less clear. This is a sign of both the maturity of industrial vision, and the broad diversity of industrial applications.

Well then, what will be the most important development in machine vision software in the next decade?

B. Silver: Hopefully, what I'm working on right now… I hope I'm proven wrong about industrial vision being past the stage where a single new development stands out as "most important", and I hope some ambitious young kid figures it out, although he or she is going to have to compete with some pretty ambitious middle-aged guys still hard at work. Look for developments in one of the following areas:

Image analysis: We've done a great job at squeezing information out of a single image, and I've long believed that to do better we need more information from the scene, such as could be produced using 3D or motion. I have a strong personal interest in motion, because it produces lots of information about objects, requires no fancy hardware, and few others in industry seem to be seriously working on it.

ID: The next decade will see image-based ID largely replace laser scanners in almost all applications areas, not just industrial ID. This will be driven to some extent by increasing use of 2D symbology and demand for capabilities such as saving images of codes that can't be read, but to really replace lasers the image-based systems will have to read 1D barcodes as well as or better than lasers, and this means yield, speed, field of view, and cost. We can already do this in some industrial applications, but for wider use look for some groundbreaking software.

User Interface: User interface revolutions are rare but powerful. I still think that the most influential in the 30-year history of industrial vision is Itran's 1983 GUI. There has been a lot of great work since, but none as broadly influential. I don't know what we might see in the coming decade, but the potential for importance is always there.

Computational Optics: The laws of physics impose limits on depth of field and object speed as a function of illumination brightness, and exceeding these limits causes loss of the higher spatial frequency information that is crucial for pattern recognition, ID, and the like. Computational optics allows one to recover the higher spatial frequency information that we need by giving up some information in lower frequencies in which we are less interested, thereby extending the physical limits. This requires

some fancy hardware as well as software, and it may well be of great importance in the coming decade.

What do you see as the major challenges for machine vision yet to solve?

B. Silver: Newton could have been describing machine vision in 2010 when he said, "I was like a boy playing on the seashore, and diverting myself now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me." Unlike Newton we pretty much know what that "great ocean" looks like, and that is human vision, but we are hardly closer to it than we were in 1980 when the vision industry started, or in the 1960's when they connected an image dissector camera to a PDP-6 at the Artificial Intelligence Lab at MIT. I'm one of those who believe that in principal a machine can do anything human vision can do, but that in practice it may take centuries. Indeed I don't think it's possible to separate competence in machine vision from the general problem of machine intelligence.

We observe a trend that machine vision software more and more migrates into hardware (like vision sensors, 3D sensors, vision processors) and is sold as integrated part of such hardware as opposed to be sold separately as a library. Do you at Cognex see this trend as well?

B. Silver: We do see that trend, but I wouldn't say that it is in opposition to vision being sold as a library. The trend represents an expansion of the market, not a zero-sum shift from one to the other.

Right now a lot of 3D functionality in machine vision software enters the market with suppliers putting the „3D" label on very different tools and approaches. What can the vision user do to make a right decision here among the different products?

B. Silver: Vision suppliers may be causing trouble for each other in the area of 3D. Most 3D functionality seems to be at prototype or demo level rather than production quality. The technology looks pretty good at a trade show but is either difficult or impossible to set up, calibrate, train or deploy without custom engineering from the vision supplier. When potential customers give it a try, they end up with a bad experience and tend to avoid 3D in the future.

There are many 3D vision methods, starting with different approaches for image acquisition and illumination (single camera, multiple camera, time-of-flight camera, simple illumination, laser light, structured illumination, coded illumination, etc.) and continuing through a myriad of techniques for estimating/inferring 3D structure from the image information (triangulation, stereo, photometric stereo, structure from motion, shape from shading, etc) and then multiple techniques for alignment and inspection that take the 3D information as input. It is clearly difficult for a user to choose the right approach and right vendor.

So the advice to users is: 1) Consider a 2D system first (instead of a 3D system) that they already understand, especially if the vision task may not merit the additional work of 3D; 2) Consider a reputable vision vendor with experience and technical depth; 3) Be skeptical of technical claims; 4) Ask lots of questions and listen for answers that make sense; and 5) Ask the vendor/integrator to walk you through their proposed solution to your problem.

Which are the topics on Cognex' software road map into the future?

Silver: We intend to maintain and expand our technical leadership in pattern recognition, ID (1D and 2D symbology), 3D, and other areas of interest to our customers. This is not just meaningless spin; our best people are actively at work in these areas right now.

Thanks a lot for your insights, Bill. It was – as always – enlightening.

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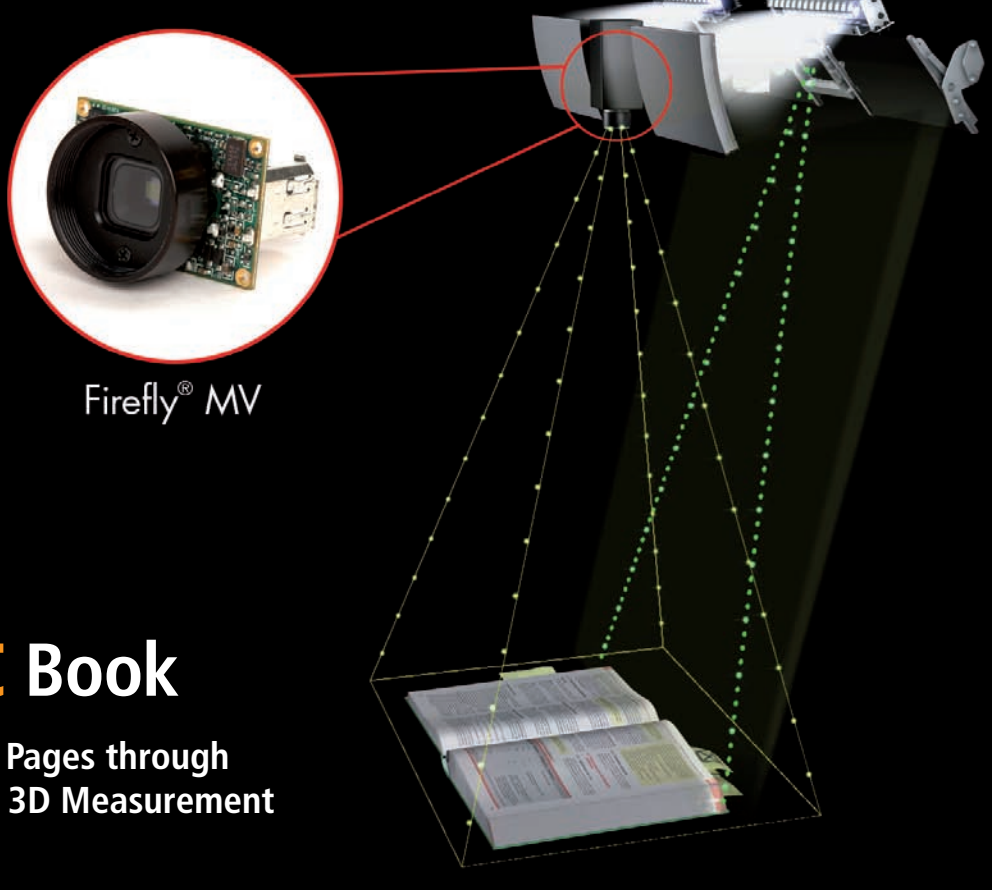


Perfect Book

Dewarping Curved Pages through Book Scanner with 3D Measurement

We've all been there. Standing in front of the university photocopier, our Physics 101 textbook laying face-down on the copier glass, pushing down on the lid with all of our strength in a vain attempt to flatten the pages out and make them somewhat legible. Of course, even with this time-honored technique of trying to achieve an undistorted copy of the written word, the result is rarely what is sought after. Even with most digital book scanners, correcting for the distortion produced by the curvature in the area of the spine, or fold, of the book has been almost impossible.

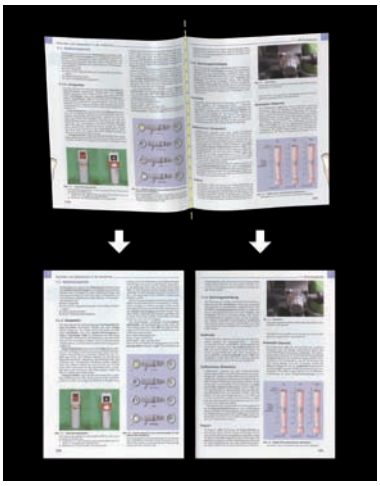
The problem of producing undistorted and evenly illuminated digital representations of the pages of a book, particularly without damaging the book in the process, is one that has faced above all the libraries and museums. Electronic reading of information in paper-bound form by means of optical character recognition (OCR) has also been subject to a high error rate due to the distortion caused by the curvature of the surface. However, distortion-correction methods that use mathematical algorithms often have limitations in the practice.

To address these issues, Zeutschel from Tuebingen, Germany, a provider of digital and analog storage systems for the documentation and archive management industry, began work on a new solution. Therefore, the company partnered with OEM industrial image capture system supplier Chromasens from Konstanz, Germany. The result is the Zeutschel OS 12000 Bookscanner with Perfect Book, an add-on 3D scanning module.

The Book Scanner's Setup

The OS 12000 system is comprised of a cradle for supporting a book (opened face-up) and an optical system positioned above the cradle. The placement surface of the book cradle is divided in the center into two height-adjustable page surfaces, enabling a horizontal scan surface. The cradle can be adjusted to accommodate the binding of thicker books up to 10 centimeters thick. A glass plate, typically

The line scan's projection is moved over the book (green) while the area scan camera (yellow) is pointing down at the cradle



With the 3D information, the pages can be dewarped and are displayed separately

used in other digital copier systems, does not need to be placed on top of the book. This allows gentle digitization of fragile originals. The OS 12000 optical system consists of a high resolution line scan camera, LED illuminators, a mirror, and a motor controller for the focus and mirror systems. Light from the LED's affects the scanning material for a short period of time, which minimizes damage of valuable documents.

Creating a 3D Model

In addition to the line-scan camera used for high-resolution texture capturing, the Perfect Book module requires a second area scan camera and uses the principle of light section to capture the 3D surface contour of the page during the scanning process. Accurate calibration of the optical components is a key requirement for the 3D reconstruction. The area scan camera is first calibrated with its lens to generate a camera model, and then with the high resolution line scan camera so that the software knows which pixel in the hi-res image belongs to which 3D point.

Camera Data

The line scan camera used by the OS 12000 is an OEM FireWire color line scan camera developed for Zeutschel by Chromasens, which is equipped with a lens designed for very low longitudinal chromatic aberration. The area scan camera is a board-level Firefly MV IEEE 1394a (FireWire) digital camera from Point Grey. The compact camera, which measures just 40 x 25 mm in size, is equipped with a 4.5 mm C-mount lens from Goyo and is housed in a custom enclosure pointed down at the cradle. The image sensor used by the Firefly MV is a wide-VGA 1/3-inch global shutter monochrome CMOS from Aptina that has near-IR capability in the 850 nm range.

Teamwork of Cameras

The projection of the scanning line and LED illumination line is moved over the original by a system of pivoting mirrors. The movement of the light is synchronized with the line scan camera. Each one-dimensional image from the line scan camera is transferred to the PC, where it is assembled into a high resolution two-dimensional image. During the scan, the Chromasens camera sends a hardware trigger signal to the Firefly MV, which is equipped with a general purpose input/output (GPIO) connector. The Firefly MV supports asynchronous hardware and software triggering. This feature allows the start of exposure, which can range from just 600 µs to 1 ms, to be accurately synchronized between the two cameras.

Creating a Virtual 3D Surface

The individual low-resolution images are streamed from the Firefly MV over the 400 Mbit/s FireWire interface to the host PC, where they are used to construct a 3D representation of the book. The fully-assembled image from the line scan camera is then texture-mapped onto the 3D image to create an exact, virtual 3D surface model of the book. Using the 3D information, all the characters are aligned exactly straight. The software also corrects character spacing and width, and uses interpolation algorithms to remove unwanted elements such as the operator's fingers and inlay sheets. Finally, the dewarped, flattened high-resolution pages are automatically separated and displayed. The system takes just 1.4 seconds to perform a 300 pixel-per-inch (ppi) grayscale scan of an A2-size document. A color scan takes only 4.6 seconds.

The Successor

„We've recently completed work on a new version of Zeutschel's system, the OS 12000 V, which features a v-shaped cradle designed for more valuable books," says Frank Sczech, Team Manager Software Development at Chromasens. „One key difference in the optical system is that it uses two Firefly MV cameras, where each camera is responsible for the 3D generation of either the left or right pages of the book. The source code examples and documentation provided with Point Grey's FlyCapture SDK made integrating their cameras quite easy, and when we had questions or issues, we received fast and professional technical support." The cameras are operating without problems in hundreds of scanners in the market. Truly, this combination of camera, optics, software and mechanical design comprises a system, which enables everyone to operate a Zeutschel book scanner with unprecedented ease of use leading to its success.

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Camera Alliance

Interview with Jürgen Hartmann and Andreas Schaarschmidt

Just recently a cooperation was formed between camera manufacturers SVS-Vistek and IDS Imaging Development Systems. Both companies develop and produce cameras for machine vision and other fields for quite some years. The range of products is comprised of USB cameras as well as cameras with Gigabit Ethernet interfaces and complements each other very well. During an interview with INSPECT the CEOs of both companies explained the background of this new camera alliance and their future goals.

INSPECT: SVS-Vistek and IDS Imaging Development Systems, both companies being camera manufacturers for machine vision and other industries, recently announced their future cooperation. Mr. Schaarschmidt, Mr. Hartmann: in which areas do you see cooperation between both companies?

J. Hartmann: Today, the product line from IDS concentrates mainly in CMOS and CCD technology. With these technologies, IDS is able to offer a wide variety of cameras, from cost-effective USB single-board cameras to high-end CCD GigE camera models. However, in the past, we were not able to offer cameras with high-resolution CCD sensors from Kodak. After deciding that we will not incorporate these sensors by ourselves, I started looking for a suitable partner. While doing this, it was important for me to find a partner whose product range overlapped as little as possible with our own product portfolio. With SVS-Vistek we have found a partner fulfilling this criterion. There's almost no overlapping between the products from IDS and SVS-Vistek which represents the perfect basis for our sales cooperation.

A. Schaarschmidt: SVS-Vistek's products combined with the product offering from IDS form a complete and technologically perfect product line. Accordingly, our specialties, high-resolution cameras, fast image rates and the GigE Vision technology may now be used in its entirety also by IDS customers. IDS and SVS-Vistek will now be jointly available to the largest market in Europe as manufacturers of cameras, distributors for AddOn components, software and services.

Will the companies also join forces and resources in product development, and align the development of their respective product portfolio as well?

J. Hartmann: At first, IDS is going to include SVS-Vistek cameras in their product offerings. However, we are not planning to combine our development processes. But it is undoubtedly right, that IDS has to think over if it makes sense to develop a camera that SVS-Vistek has already developed.

A. Schaarschmidt: We are just at the beginning of a new sales partnership between two companies offering quite similar concepts of the company and of values. Both are, individually seen, highly successful in handling their respective customers who, besides, differ very often. Until now we have not yet defined any final goal, but we will surely exchange ideas on our "road maps" and perhaps even generate common ideas. The market for "imaging electronics" is broadening, and our partnership will surely improve any use of synergies.

What are the benefits your respective customers will get out of the cooperation?

J. Hartmann: During our daily work we are continually confronted by new projects requiring a sensor technology which our product line does not contain. Up to now, IDS was not able to realize all customers' requests concerning this area of sensor technology.

A. Schaarschmidt: Existing customer relations may now become even more extensive, as it will now be possible to entirely cover the most interesting camera technologies. Almost every project will

now find the 100% matching solution. To obtain good products through experienced logistics together with a perfect after sales service is certainly always beneficial for business partners. – Isn't it one of the most beautiful experiences for both sides to instill trust?

Mr. Schaarschmidt: will SVS focus more on product development in the future and rather delegate direct sales to distributors?

A. Schaarschmidt: From a present-day perspective: no. Due to my own history in this field, I've always been a customer advocate, and we love to be involved with our customers' activities. According to the SVS-Vistek business model, we are about to add a variety of further USPs, such as add-on distribution, system consulting, and software, to the cameras of our own as kind of a link, particularly for the important local market. Last year, however, we've also heavily enforced our international sales channels. We are proud to say that we have found stable new partners and business associates especially in Europe who should be supported at our best. We will split up and divide up our activities, perhaps acquire new colleagues, so as to keep on growing with the same spirit. It is our intention to maintain the direct contact to our local and simultaneously most interesting market as part of our business policy.

Mr. Hartmann, will IDS concentrate more on distribution – the company already is very successful as vendor for MVTc's Halcon software for many years now – and take on additional camera manufacturers besides SVS?

J. Hartmann: It is maybe best to answer this question with some facts. This year, IDS and its approximately 80 employees have made 85–90% of the turnover with their own products. In the first six months of 2010, we have produced and delivered more than 20,000 cameras. That puts us on a path to have about 45,000–50,000 cameras shipped during the fiscal year of 2010. That would be corresponding to a weekly production of nearly 1,000 cameras. At the moment, I think it could be possible that the share of IDS camera products grows to more than 90% of the overall turnover, despite the considerable increase in Halcon sales, and hopefully, successful sales of SVS-Vistek cameras. Nevertheless, the products we are dealing with are without any question a key to accessing the market and we will still push them ahead and extend them.

What is your view on the future development of the market for industrial cameras?

J. Hartmann: The continuous upward trend of the camera business will be carried on with one exception: In my opinion, the resolution of the cameras will not continue developing as fast as right now. I can see coming new markets by using new sensor technologies. Last year at the Vision fair, we had the good fortune to be the first company presenting some innovations like the 10MP CMOS-sensor from Aptina, the probably smallest USB-camera worldwide including an integrated autofocus lens and moreover a brand new HDR-sensor with 120 dB. All three technologies will open up new markets for us in the future.

A. Schaarschmidt: Up and up, faster and faster, on and on: optimally at a same or even better price. This is the law of progress in almost every branch of trade. Depending on the field of application, considerably more programmable flexibility will be contained in a camera's casing. (I strongly oppose the term 'smart camera'!) High resolutions at very fast image rates will surely become a distinct trend. And there will be tremendous improvements in the sensor technology. Just imagine the possibilities for camera applications beyond visible light. And: every user market will be eager to find its specific needs more and more integrated into the hardware/software. We know that a single company can never get 'magna cum laude' in all fields, and that's why our partnership possibly starts at exactly the right moment.

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In our anniversary issue of the INSPECT we would like to point out a couple of Machine Vision groups in social networks:

http://www.linkedin.com/groupRegistration?gid=3185080

■ Exhibitors and visitors of the leading trade show for machine vision, Vision in Stuttgart Germany, meet each other in the Vision group at LinkedIn. Currently this group has 316 members.

https://www.xing.com/net/pri851222x/machinevision/

■ The Imaging & Machine Vision group at Xing is a platform for the exchange of data and information to market, business and technology topics for the ever increasing community of machine vision. Communication language is by choice either English or German depending on the international reach of the individual member. The group has currently over 600 members.

http://network.inspect-online.com

■ The INSPECT network offers groups for users interested in specific topics. Members can also set up their own topic or member specific groups. The department of "Optical Technologies and Machine Vision" at the University of Applied Sciences Darmstadt, e.g., is operating their Alumni network here. The INSPECT network in total has about 270 members at this time.

http://www.facebook.com/group.php?gid=2417304180&ref=search

■ A global new connection through Facebook for those students, engineers and scientists working on computer vision, image processing and pattern recognition. The group currently has 947 members.

http://www.linkedin.com/groups?about=&gid=125935&trk=anet_ug_grppro

■ The largest LinkedIn Machine Vision Group has currently 1,700 members. This group is for everyone who likes to explore and expand their network of machine vision professionals.

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

Another Cuppa Tea?

The Visual Perception of Service Robots

When robots offer guided tours through museums or serve a cup of tea to their owners, it depends mostly on their perception system whether they solve this task gracefully or not. They have to avoid obstacles, and detect objects directly in front or behind them. Therefore, exact 3D measurements are crucial.

Since time immemorial, humans have been dreaming of automatic assistants which relieve them of work. We think about having robots at home that iron clothes, clean or cook dinner. But not only should they relieve us of unpleasant tasks. We are also imagining the scene where they serve us, for example, another cup of tea. His empty tea cup was also what inspired Czech play writer Karel Capek 90 years ago to invent the robot – in a novel.

Since Capek's publication, a lot has happened and robots are now more widespread, although still not as much as some science fiction movies would suggest. Since the 1920's, single robots have been constructed here and there, but it was not until the 60's and 70's when there was a boom in research and development of robotics, which eventually led to the introduction of industrial robots in many industries. The automotive industry has been a driving force, starting with the triumph of the welding robot in the 1970s.

From Chess Player to Allrounder

In the years after 2000, the new digital era has lead to the realization of humanoid robots. Nowadays, robots in the shape of human beings can be constructed and are introduced in various markets. This is the task of the Spanish Company PAL Robotics. The young and dynamic company consists mostly of engineers and was created as a research and development company of humanoid robots in 2004. In these times, four engineers started to develop their first humanoid biped robot, REEM-A, that was able to walk and play chess.

The next prototype, REEM-B, which is recognized as one of the most advanced humanoid biped robots, has brought PAL Robotics to the level of world players in the robotics industry. REEM-H is the result of further investment and research; however this version became more focused on commercial purposes.

REEM, the latest humanoid service robot created by PAL Robotics, is their bet for the future: This new prototype weighs about 85 kgs, and is 1.70 m tall.

REEM's Vision System

One of its main features is the robot's vision system: REEM's head is equipped with a stereo rig composed of two FireWire color cameras. Such setup pro-

The service robot REEM's task is to guide visitors through museums

With its integrated touch screen, the service robot REEM-H provides information to the guests of a hotel, e.g. the weather forecast or the sightseeing hot spots

vides a vision system that is capable of accurate 3D measurements based on classic triangulation of sparse correspondences as well as dense point cloud reconstruction based on dense disparity calculation. The cameras are mounted in a 6 cm baseline and they have 1/4“ CCD sensors and 2.8 mm lenses providing VGA resolution. This configuration provides a good trade off for middle and close range perception. Therefore, manipulation tasks of objects at a distance of less than a meter, as well as the detection of objects that are few meters away, become feasible with the same cameras. Furthermore, the cameras have progressive scan CCD sensors and manual shutter so they can be adjusted to mitigate image blurring when the robot is moving and minimize flickering due to indoor illumination. The acquisition rate can increase up to 30 frames per second at VGA resolution, which is good enough for robot perception algorithms in complex environments that require high computation time.

Some tasks that can be performed with this stereo camera are people detection and tracking, textured object recognition and obstacle avoidance. The robot also has a webcam placed in its back allowing it to keep track of persons behind the robot.

Fields of Applications

This vision system, combined with the robot’s autonomous navigation system, its user-friendly touch screen, and its voice recognition system, ensures that REEM finds its way in various surroundings and can help or entertain people in most public environments. Besides helping out as a guide or amusing people as an entertainer, REEM can also transport small packages. Its dynamic information point can furthermore be used with a wide variety of multimedia applications: display an interactive map of the surrounding area, call up a variety of information like the weather, nearby restaurants or the airline travel time, or, for instance, offer tele-assistance via video conferencing.

Potential markets are luxury hotels, trade shows and events, entertainment and attraction parks, holiday resorts, and museums. Also healthcare, elder care, universities, R&D institutes and some semi-industrial applications are possible application fields for such a service robot.

A Modular Concept

PAL Robotics is convinced, that there is a future for service robots. “It’s not if, it’s more when and where the first humanoid robots work together with people,” states Jan Jonckheere, Business Development Manager of PAL Robotics. They believe in its modular system of building robots that offer all elements – from electronic actuators over robotic arms to mobile bases – separately. So there is a powerful technological platform on which their clients can build virtually any service robot – REEM is only one example of what is possible.

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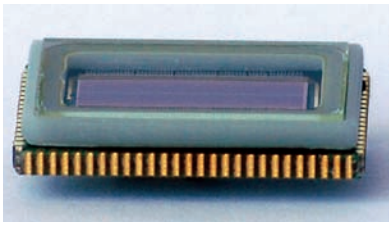
New Sensor for High Speed Series

Awaiba announces the release of a new dual line sensor to its high-speed digital line scan sensor family Dragster. The DR-2x2k-7 sensor features a dual line of 7 µm x 7 µm pixels and operates at up to 160k Lines/second. The dual line sensor mode permits in high speed scanning applications to increase in TDI like operating scheme the effective integration time. Combined with a low read noise and high sensitivity the sensor is the ideal choice for any high speed scanning application. The sensor interface is identical to the one of the other Dragster line scan sensors. The all digital interface and single 3.3 V supply make it easy to integrate the sensor. Main applications of the dual line sensor are in solar cell inspection, high speed print inspection, sorting applications, slide scanning and surface inspection.



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Panel Machine Vision System

With the advantages of a panel PC and the capacity of the image processing software Vision P400, Panasonic's new Imagechecker P400PD offers an effective solution for myriad inspection tasks. The use of mass market technologies such as Gigabit Ethernet and an Intel Atom CPU save costs without compromising on sophistication. By default, the Imagechecker supports two Gigabit Ethernet cameras, though the number can be extended by using switches. Currently, four different camera types are available and boast a maximum resolution of 5 megapixels per camera. The P400PD is delivered ready to use and is equipped with the latest version (5.0) of the multifunctional image processing software Vision P400 Essentials. It provides algorithms for almost all common inspection tasks such as size measurement, contour checking, object identification, feature recognition, OCR and 2D code.

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Powerful GigE Cameras

GigE Vision cameras from Baumer now contain extended firmware with advanced functions that increase their versatility and usefulness. For example, the new release provides innovative functions like Timer and Multicast. The timer function permits independent and flexible exposure control for the camera sensor, allowing the illumination to be triggered before or delayed after the start of the exposure time and the exposure time to be set independently. Inputs such as TimerDelay and TimerDuration can be adjusted separately. The Multicast function enables the sending of single images to one or a defined group of computers within a network. Used properly, the Multicast function allows different machine vision tasks to be solved simultaneously using separate computers. This improved firmware is contained in the new TXG models.

Baumer
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Frame Grabber Supports Fast Camera

Silicon Software is introducing a new PCIe x4 frame grabber which supports the Basler A406k/kc at its full bandwidth. The combination of these fast components represents a powerful system available for industrial imaging. The microEnable IV series supports the maximum Camera Link speeds via a PCIe x4 interface. It reaches a transfer rate of 837 megabytes per second in a 10 tap, full configuration mode at the camera's full 2,320 x 1,726 pixel resolution and a repetition rate of 209 frames per second. Because the data is transmitted via a DMA channel into the host RAM, additional processing for image reconstruction is not necessary. The frame grabber is multi-board enabled and supports the use and synchronization of multiple full configuration cameras in one system.

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Long-range 3D Vision Cameras

TYZX, a 3D vision technology company, introduced TYZX DeepSea XD series of long-range stereo vision cameras for use with the TYZX G3 Embedded Vision System (EVS). The new XD cameras excel at providing accurate range data in real time at distances up to 128 m and can be used for applications such as detecting and tracking people and objects. The XD cameras extend the operating distance of TYZX's DeepSea G3 EVS - small, fast, rugged, and smart 3D vision system that provides reliable, real-time range data for robots, security systems, and other applications. The XD cameras feature longer stereo baselines of 33 cm and 50 cm, Aptina CMOS WVGA imagers (752 x 480) with full-frame shutters, and 40°, 62°, or 80° horizontal field-of-view lenses. Color vision is available as an option.

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Giant Billboard in Times Square

Fashion retailer Forever 21 opened its new 90,000 square feet flagship store in New York City's iconic Times Square. The store features several interactive displays including a giant 61' high real-time digital billboard that uses an AVT Prosilica GX1910 GigE camera. It supports a dual GigE interface with 240 MB/s and is equipped with a 3-axis lens control and a thermal management enclosure. The camera sits on top of the 61 feet high digital billboard and looks down at the crowd feeding image data to the application. The billboard uses computer vision technology to first identify people looking at the billboard and, in near real-time, builds a composite image of the crowd for use in the simulation. The simulation involves giant onscreen models that interact with the crowd by picking-up shoppers to toss them under a hat or in their shopping bags.

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The Holy Grail

History of Bin Picking

Entropy, or natural disorder, is evident extensively in nature. We as human beings find it naturally easy to see objects in an unordered environment and then to touch or pick them. We do it many times each day; often without even thinking about it. What makes this possible? Many capabilities, but at a simple high level, just three things: 1) the ability to see with our eyes and then to transmit the sight information to our brains, 2) the ability to figure out "where" the seen object is using our brains, and 3) the ability to transmit the "where" location information from our brains to our limbs to touch or pick the object(s).

We as human beings have often tried to replicate this natural ability in the machines we invent. The science and art of seeing objects in an unordered environment with cameras and then to attempt to touch, act on, or pick them with robots is called "Bin Picking". Bin Picking is performed in much the same way as we humans do this task; by 1) seeing with cameras and transmitting the visual information to mechanistic brains or computational devices like PCs, 2) by computing the "where" location of one or more objects, and 3) by transmitting the "where" location information from the computation device to a robot to touch or pick the object(s).

The Enabling Journey

Objects or components for assembly in factories are often found resting randomly in bins. Ever since robots were introduced 30 to 40 years ago, Bin Picking has been a desirable goal for manufacturing for several commercial reasons e.g., labor savings, throughput, quality, safety and reuse of the same bins or containers. In 1986, Professor Berthold Klaus Paul Horn at MIT wrote in his famous book "Robot Vision" [1]: "One of the remaining obstacles to the widespread introduction of industrial robots is their inability to deal with parts that are not precisely positioned", and he went on to offer several computational and practical ideas to make Bin Picking possible. Mechanistic, electrical or computational breakthroughs that make Bin Picking possible or easier are called "Bin Picking Enablers."

The need for bin picking enablers has been acute since the more we investigate the challenge, the more we marvel at how amazing our natural human capabilities are. Bin Picking is challenging because there are 1) many types of geometries in the parts that are attempted to be bin picked, and 2) they occur in bins with various degrees of structured, semi-structured or random order. Nevertheless, steady strides have been made and these strides have accelerated in the past 10 years.

Bin Picking Enablers and Challenges

Bin Picking Enablers in order of light, sight, computation and robotic use are:

- flexible lighting,
- camera resolution,
- computational processing power,
- vision algorithms,
- mathematical algorithms for three dimensional (3D) Bin Picking object location,
- part handling techniques including part separation,
- robot grasping techniques.

Amongst these, lights have become more powerful, durable, consistent and programmable. We have seen a steady progress in resolution towards "megapixel" cameras. The almost universal use of PCs for business and personal use has spurred computational processing po-

Fanuc´s M710iC 50 stereo-based Bin Picking system has integrated vision into their robot controller

Scape Technologies have devised a highly analytical and modular approach to the components of Bin Picking

wer. Part handling techniques such as magnets, air, vibration, gravity and multistage control for precise part control have been extensively used. Robot grippers have improved in sensitivity, versatility, speed and compliance.

The most challenging Bin Picking Enablers have resided in the computational sector. In Bin Picking, it is easy to calculate 1D linear segments, 2D features and point clouds of 3D scenes. But to make sense from this mountain of data often requires significant mathematical capability such as perspective calibration, triangulation, epipolar geometry, Kalman filtering, stereo matching and situational heuristics to identify possible solutions and then to generate from them viable part pickup candidates. Many excellent papers and books have been written to assist Bin Picking in this regard. One book in particular that bridges theory and practice is "Artificial Vision for Mobile Robots" by Nicholas Ayache [2].

Manufacturing Innovation and Acceptance

There are, typically, four stages of manufacturing innovation and acceptance:
1) initial discovery or solution in a fragile lab environment with no operator interface and with questionable reliability; also called "bleeding edge",
2) adoption of new technology in a handful of installations and managed by highly trained technical personnel for limited durations; also called "leading edge",
3) adoption by several factories and reliable use for less than five years; also called "emerging",
4) adoption by most factories and reliable use for more than five years; also called "mature".

Structured or semi-structured Bin Picking (in which parts are staggered or skewed but not randomly placed) is currently in the third "emerging" stage. Random Bin Picking (in which parts are randomly placed) is currently in the second "leading edge" stage. Both areas are destined to improve in the future.

A notable marker in Bin Picking progress was documented in Automation World in February 2006 and entitled "Vision Guided Robotics: In search of the Holy Grail" [3]. In this article, several actual Bin Picking solutions e.g., from Fanuc Robotics and Shafi, Inc. were mentioned. Since then Bin Picking has been covered regularly in industry trade shows, conferences, publications and there are many impressive references on the Internet.

Viable Applications and Implementation Methods

The following applications have now become feasible for reliable Bin Picking:

Automotive:

- PowerTrain (Engines, Cylinder Heads, Axle Shafts, Differential Carriers, Pinions, Round Parts with Stems, Connector Rods, Piston Heads, Brake Rotors and Stacks of Gears);
- Stamping (Flat or bent metal plates with multiple holes, stacked stampings with a progressive skew);
- Final Assembly Products in Boxes in car assembly (Trim Chassis Final) pick operations for placement into cars on moving lines.

Packaging:

- Strips of medical tablets, flat but randomly arranged in boxes;
- Bags of products e.g., chips, salsa, cheese, cement, etc.;
- Lateral or upright layers of tubes (copper, plastic, PVC);
- Layers of products e.g., wooden planks, plastic sheets.

A systematic methodology to specify and implement Bin Picking in a reliable, successful manner is covered in the article "How to Implement Bin Picking in your Manufacturing Operation" [4].

Established Industrial Companies

There are several companies involved with offering reliable Bin Picking solutions to the industrial manufacturing community. They include Fanuc Robotics and Scape Technologies who kindly provided pictures for this article. Fanuc Robotics has a leading market share in Vision Guided Robotics and they have integrated vision into their robot controller. Innovators from Scape Technologies have devised a highly analytical and modular approach to the components of Bin Picking e.g., workcell design, geometric feature training, gripper management, and communication protocols.

Expectations and the Road Ahead

There has been no "magic bullet" or technique to solve all geometries for Bin Picking. Instead a collection of techniques and algorithms have developed to chip away at the overall problem. This trend is expected to continue with additional Bin Picking Enablers in the future e.g., the design of custom VLSI chips to perform current software techniques more quickly in hardware. Color and light handling techniques are expected to provide more viable candidates amongst heaps of random parts for Bin Picking. Material handling techniques derived especially from space, surgical and rehabilitation handling experience are expected to make Bin Picking more flexible, versatile and fault tolerant.

Ultimately it will take significant advances in cognition and fast real time mathematical interpretation of raw camera or laser data to truly solve the most difficult problems in Bin Picking. Unlike the Turing machine halting problem, there seems to be no theoretical computation impediment to achieve Bin Picking for all geometries with any random order; this is what makes Bin Picking so appealing to our creative and problem solving nature.

References

[1] "Robot Vision" by Berthold Klaus Paul Horn, © 1986 by the Massachusetts Institute of Technology

[2] "Artificial Vision for Mobile Robots" Stereo Vision and Multisensory Perception by Nicholas Ayache, © 1991 by the Massachusetts Institute of Technology

[3] Automation World, http://www.automationworld.com/feature-1878 in February 2006 and entitled "Vision Guided Robotics: In search of the Holy Grail"

[4] Robotics Online, http://www.robotics.org/content-detail.cfm/Industrial-Robotics-News/How-to-Implement-Bin-Picking-in-your-Manufacturing-Operation/content_id/1787 in April 2007 by Adil Shafi

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Packaging's Potency

Mettler Toledo Extends Its Product Portfolio with Optical Inspection Solutions

Product recalls will particularly harm the image of a food or pharmaceutical company. After a recall, 21% of the consumers will never buy a product of the company again. 50% will temporarily change to another brand, and 14% will never buy the brand again. Vision inspection supports and maintains the market value of a company. Mettler Toledo, supplier for product inspection solutions, extends its product portfolio by vision inspection technology. We spoke with Birger Becker, managing director of the division Product Inspection Germany, about the reasons for the business expansion.

INSPECT: Mr. Becker, Mettler-Toledo offers the customers a broad portfolio for detection of contaminants in products, and for compliance with laws and international standards. What are the reasons for expanding the range of products by solutions for vision inspection?

B. Becker: We offer an overall product inspection concept to our customers. While checkweighing, metal detection and X-ray inspection focus on the content of a product, vision inspection systems mainly check the packaging. Therefore, the vision inspection would be an ideal completion of our product portfolio, and will strengthen our market position, since we will be able to offer an overall solution to our customers.

Mettler Toledo has taken over CI-Vision, the American specialist for inspection. What are the advantages of cooperation with CI-Vision?

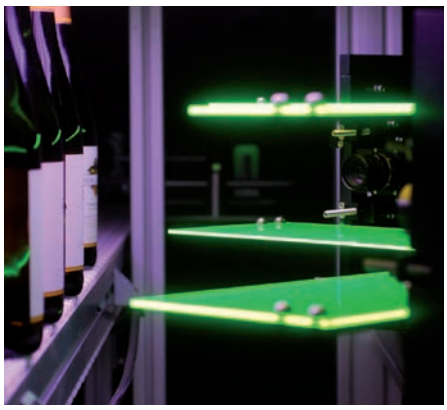
B. Becker: In 1979, CI-Vision was founded in Chicago, and has gained a long-term experience in vision inspection technology. Up to now, about 2,000 solutions have been installed successfully at customer sites. Among the customers of CI-Vision are large companies, like for instance Johnson & Johnson, L'Oreal and Heinz Ketchup. CI-Vision offers a broad underlying experience which Mettler Toledo can use immediately to offer high-level and complete solutions for the production lines of our customers.

What role does vision inspection technology play for your product portfolio?

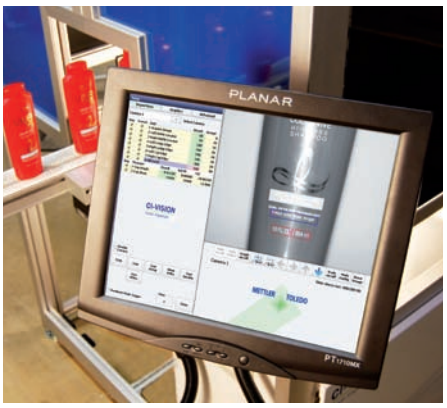
B. Becker: We have asked our customers about the reasons for product recalls. The answers showed that about 17% of all product defects can be drawn back to an incorrect labeling, and thus to defects of the product package. Defects of labeling can only be detected by a vision inspection system. Faulty, flagged, disrupted, missing labels, as well as sloped or double attachment of them will not only give a non-professional impression to the consumer, but will also impair the product image in the long run. And it would be fatal if, for instance, an ingredient is not listed on the label, but is contained in the product.

Many companies employ staff members to inspect optical aspects. What are the reasons for automated technical solutions?

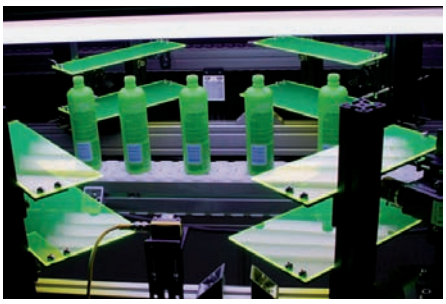
B. Becker: Today, production lines can have a throughput which is far in excess of 1,000 products per minute. A visual inspection would hardly be able to keep



The machine vision system inspects if the label is positioned in the right way



The CI-Vision solution inspects packaging at L'Oreal



An all-in-one system checks the filling level, the label and the closure simultaneously

pace with such a speed. Moreover, according to our market analysis labeling defects are based on operation errors, inappropriate visual inspection and operational failures. Another cause for labeling defects is the handling of system processes.

Vision inspection solutions can detect and prevent a high percentage of the errors, and can thus protect a brand in a process-safe way.

In which fields is an inspection possible?

B. Becker: Our vision inspection system can assist to check, for instance, the correct closure of a bottle – an incorrectly closed product can spoil and thus can be the cause of a product recall. In case of an inline production, series errors can result in pallets of faulty products.

Our vision inspection systems are used very successfully for label control. They verify the correct and straight positioning of the label on the bottle, or check for torn labels. Another key application is the inspection of the best-before date. In addition, vision inspection solutions can check the product integrity and completeness. Our systems will detect, if a box is not equipped completely, or if the glass of the bottle neck is broken.

The position of the inspection solutions in the production line does not matter; vision inspection should be one component of a comprehensive quality management. Since we offer an overall concept to each customer, the application under inspection and the number of control points will be determined individually for each customer after in-depth discussions.

Can you describe the technical implementation into a system of Mettler Toledo?

B. Becker: Our terminal can control up to four control points per line, where one control point can be equipped with several cameras and can perform different tasks. For example, one system can check the package, the filling level, the label and the closure simultaneously. All processes are controlled by a single terminal. In doing so, faulty products will be detected directly at the beginning of the product chain, will be rejected, and passing of further production steps up to the final inspection will be avoided. The terminal also offers an overview on the state of all control points, which allows early identification and prevention of series errors in the production process.

Vision inspection solutions should be part of a comprehensive quality management. This is the only way to safely prevent product recalls and harm to the customer's image.

Mr. Becker, thank you very much for this interesting conversation.

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Turning the Blades

Consistent Life Cycle Monitoring Concept for Gas-Turbine Blades

The life of a gas-turbine blade is hard: The prevailing combustion temperatures are about 1,000°C and rotation speeds of up to 60 revolutions per second take high-performance materials to their limit. Therefore an inspection on a regular basis is necessary, as a failure of the blade can lead to severe damage to the turbine. A multi-sensor system fulfills now the needs of different inspection tasks from manufacturing till service inspection: the Global Inspection System.

Depending on the point in time of the blade's life-cycle, the Global Inspection System combines different non-destructive evaluation technologies in one device, ranging from image processing procedures to various active thermography techniques. All systems have the same mechanical base frame in common. A swivel-mounted turntable holds the turbine blade that is going to be inspected, allowing an automatic data acquisition from all sides with tailor-made testing recipes for different blade geometries. Currently the system is specified for objects with a maximum of 54 cm height and 57 cm diameter, weighing up to 50 kg.

During Manufacturing

In order to resist the powerful thermo-mechanical forces inside a turbine, the blade is made from a special high-strength metal alloy. Furthermore it is coated with heat-resisting ceramics, the Thermal Barrier Coating (TBC). Compressed air is led from the inside of the hollow blade through numerous cooling holes in order to lower the blade's temperature effectively.

Before the first operation of a blade the thermal barrier coating has to be tested for proper adhesion and the cooling holes for blocked channels. For these so called delamination and transmission tests, the Global Inspection System uses a high resolution infrared camera, two flash lamps and a special hot air hose. By flashing the blade's coating it gets heated for a short period of time. In an image sequence captured with the infrared camera the cooling of the surface is analyzed. Hollow spaces between coating and base material cause a heat accumulation, enabling the algorithm created by Siemens Corporate Technology to visualize them. The hot air hose is used to produce 100°C warm air that is led through the blade alternating with air in room temperature. This way blocked cooling holes appear in the infrared image with a clear temperature contrast.

For the inspection of turbine blades in different dimensions the infrared camera can furthermore be moved via scripts into different heights and distances to the test object.

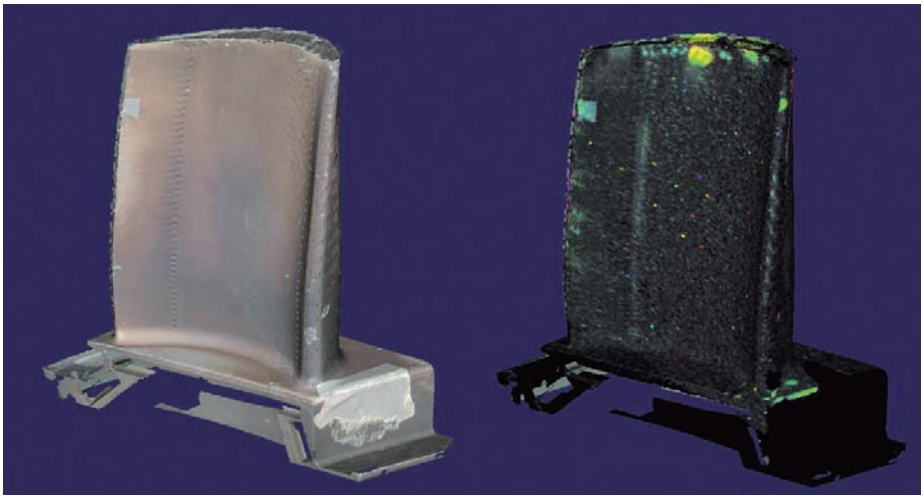
In Service

Under service conditions the Global Inspection System can be utilized for the documentation of a used blade's state before the repairing process. Here the infrared camera is employed in combination with an integrated Siemat system. The Siemens-invented Siemat technology (Siemens Acoustic Thermography) enables the detection of cracks in the base material even beneath the coating by exciting the blade harmonically with a piezo actuator. In case of a flaw inside the material there will be heating at the crack faces due to friction, which can be detected with the infrared camera and analyzed by special algorithms.

Data Fusion

In order to document the overall status of a turbine blade the techniques described above can be combined with 2D

and 3D image acquisition system consisting of an 11-megapixel-CCD camera and a full-HD projector. The collection of 2D images enables the user to employ a more standardized way of documenting the inspection process compared to earlier handwritten records. The results are stored together with all views of the blade inside a database. As the color values in the images are calibrated, data from different inspections can be compared in order to get information about the thermal stress of the blade which is represented by different tints. Furthermore the possibility exists to combine 2D images from slightly different turntable angles by a super-resolution-algorithm to a new 2D image with twice the resolution of a regular one. Another option is the illumination with UV light, causing chemicals brought into surface cracks to fluoresce and this way to be clearly seen in the camera image (dye penetrant test).



Scan result with color texture (left) as well as with Siemat texture (right), based on a test with acoustic excitation

3D Model of the Turbine Blade

The combination of camera and projector allows also creating a complete 3D model of the turbine blade. The 3D data is acquired by active stereoscopy using the phase-shift approach. The test object is positioned with the turntable in a way that the whole surface can be measured by several successive single scans. The calculated 3D point clouds are combined to a complete model of the blade surface. This data can for example be used to compare it with a CAD model to visualize the distortion of the blade by long term use inside the turbine. Also chipping of the coating and discontinuities can easily be seen. Furthermore it is possible to overlay the results from all inspection techniques mentioned above as texture layers onto the 3D model, so that for example cracks detected with Siemat can be visualized three dimensionally. This allows the calculation of statistical analysis for flaw types and their positions as well as the sizing of the defects which is vital for the repair process.

The Next Generation

Currently the information collected in the database is analyzed manually. However, there is already work in progress to detect, classify and evaluate the different types of flaws and measurements in a fully automated manner. The goal is to enable the examiner to get all inspection results in an electronic form just by inserting a blade into the system and pressing a button.

Tailor-made Life Cycle Monitoring

The Global Inspection System is the first device offering a complete life cycle monitoring concept for gas-turbine blades. It provides for each task the tailor-made solution combining different non-destructive testing methods matching the exact needs. The standardized results can easily be analyzed and bear the potential for a fully automated inspection. The result of the 3D measurement with an overlay of the blade texture and all detected flaws offers a far more intuitive approach to the inspection results than the up to now used method of numerous single pictures and defect descriptions with pen and paper. Based on its modular design the system is furthermore easily adaptable to various other test objects.

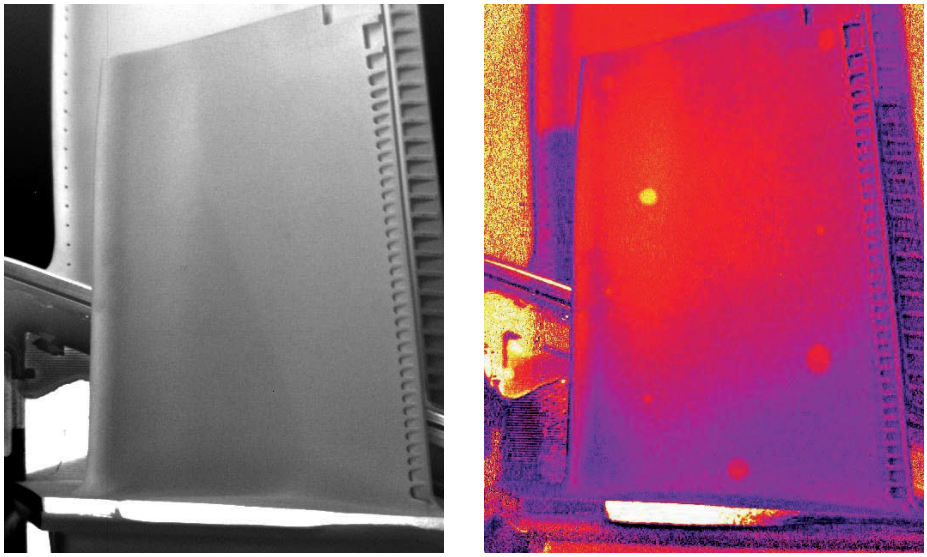


Image of a blade captured with an infrared camera (left) and evaluated by using flash thermography (right)

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Control of Electro-optical Displays

The complexity of modern electronic devices leads to increasing requirements concerning the human-machine interface (HMI). The array of the buttons, the selection of the display icons, and the design and lighting of the display become increasingly important. SAC has attended to that subject: with the additional module HTM (human test module) the optical inspection of the HMI becomes standard. Symbols, printed or lasered, can be inspected in terms of completeness, consistency of shape, and position (x, y, and angle). The brightness of the icons in day/night design can be determined, too. Displays (LCD, LED, 7-/14-Segment, dot matrix, special symbols, etc.) can be checked for their functionality with simple macro commands. Segment failures, short circuits, and completeness can be checked as well as homogeneity, color fidelity, and brightness of lighting. The HT module is fully integrated into the graphical standard interpreter Coake. Application programs can thereby be created graphically by the user easily via drag & drop.

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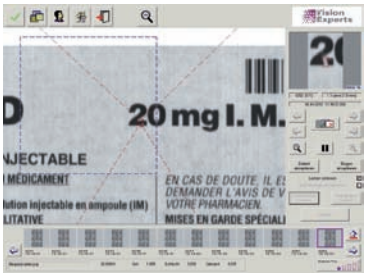
Print Inspection System for Package Leaflets

It is important that the production of package leaflets is error-free. The printing company De Melle, specialized on the production of pharmaceutical package leaflets, equipped its Man Roland 700 with an inspection system by Vision Experts. Hans-Hermann Bibel, managing director of Vision Experts, says: "Originally, we didn't expect to get this order at all, as since the delivery in mid-2008, the Man Roland 700 was factory-equipped with a camera system from another manufacturer. Yet, it turned out that De Melle's requirements, particularly the mandatory inline PDF comparison, could only be met by the Vision Experts systems." Now, the third-party equipment will be replaced by the proven solution and De Melle will receive the fourth system from Vision Experts.



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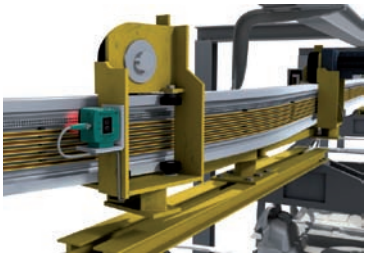
Data Matrix Positioning System

Pepperl+Fuchs presents an innovative positioning system which is based on quadratic Data Matrix codes. The codes can be positioned horizontally or vertically along a path which can be read and decoded with a camera-based reading head and the exact position output in x and y directions. The benefits are striking, for example, the highest data integrity, slim code band for the narrowest mounting sites and smallest curve radii are possible. Because a minimum of six codes are always read, there is a high code redundancy. Even with a lot of contamination or damage, the exact position is reliably determined, therefore meeting the strict requirements of material handling. The PCV reading head uses modern camera technology and, due to the elimination of laser diodes and mechanical parts, is extremely robust, and provides a long service life.



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Automatic License Plate Recognition

The main customs office in the Port of Hamburg has been utilizing a container inspection system, the Cargo Scanner, for many years. The focus of the inspections, carried out using X-ray technology, is the detection of smuggled drugs and weapons. Import and export containers, as well as trucks, are inspected. Until now, the license plates of all vehicles were identified manually upon arrival, as well as after the X-ray detection. The license plates of all countries of origin are now identified in a fully automated fashion and are processed immediately. Manual input is no longer required. Smith Detection, the integrator of the cargo scanners, decided in favor of an automatic license plate recognition system (ALPR) from Vitronic that features two cameras for image acquisition. The license plates of the vehicles are now automatically identified with PoliScan smart. This makes it possible to significantly speed up the handling process.

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GigE Vision System with 250 Cameras

For a major scientific establishment in Great Britain, Stemmer Imaging has utilized the capabilities offered by the standards GigE Vision and GenICam and developed a machine vision system based on GigE Vision with more than 250 cameras. Stemmer Imaging and its partner, Perceptive Solutions, have been working for more than a year to develop the application and control software. Each camera is connected to a bank of 2U industrial PCs via a series of high performance switches. The Common Vision Blox imaging toolkit makes the output of the server PC appear to the client as though it is a GigE Vision compliant camera and provides a highly efficient method of transmitting the image data. In live mode the output of any subset of the 250 cameras can be selected by the users for simultaneous viewing on any of the client PCs.

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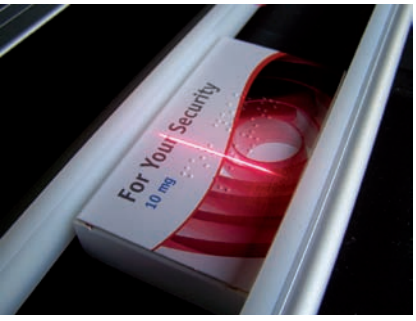
Innovative Braille Control

BrailleSpect, a Laetus solution for reading and verification, decodes inline the Braille dots of the pharma-packaging. It analyses not only the content and language of the imprint but also the diameter, height and volume of the Braille dots. The exact coverage of the height is particularly important in combination of the European Braille directive, which defines obligatory the height by 0.2 mm. The system uses 3D laser triangulation technology, enabling all Braille information to be reliably registered, irrespective of the underlying colour of the packaging. The flexibility of the BrailleSpect is outstanding: the position of the camera is variable and the product can be controlled in motion. The 3D camera is very compact and can be used even inside small packaging machines.



Laetus GmbH
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How to Lose Weight and Gain Importance

1960 to Date: The History of Industrial Thermal Imaging

When thermal imaging came onto the scene in industrial settings during the 1960s, the devices were incredibly bulky; a thermographer had to cart 60 kg of gear plus a generator and nitrogen jar to the operating location. Nevertheless, the technology showed great promise.

Flir i7 multiple application IR camera used for electrical, mechanical and building inspections in 2010

When a thermographer would inspect an electrical substation more than 40 years ago, he had to wheel around several heavy devices in the field. The state-of-the-art Thermovision 661 weighed 60 kg (over 130 lbs.), not including the 220 VAC generator that powered the unit. A 10 liter jar of liquid nitrogen was also required to cool the linear array detector. Measurement tools were non-existent and data storage consisted of snapping a Polaroid of the video display.

Despite the incredible bulk of that generation of equipment and its limited capabilities, the technology demonstrated its value in locating potential problems invisible to the naked eye. And ever since, the features and applications have increased while the models have become far less expensive. By the mid-90s, infrared cameras like the Agema 470 slimmed down to 18 lbs., boasted a resolution of 10,000 pixels, and listed for just over US$ 50,000. Today, a Flir i7 produces 14,000 pixels, weighs under 12 ounces (including the battery), and costs less than US$ 2,500.

Oil Crunch Speeds up Development

Originally, the oil crunch of the early '70s resulted in using thermal imaging for avoiding energy loss. The Swedish government took the crisis very seriously. It provided support and funding immediately for the development of the first commercial real-time radiometric imagers to help measure and quantify energy waste. The new cameras, developed by Sweden's AGA/Bofors (now Flir), featured liquid nitrogen-cooled detectors and high-speed optomechanical scanners. Later that decade, Flir entered the energy audit arena and soon after began developing handheld and laboratory systems for a variety of commercial and industrial uses. It would be well into the 1980s before infrared focal plane array (IRFPA) imagers were perfected, which improved sensitivity and resolution and ultimately replaced mechanical scanning. By the late-90s, models emerged that no longer required cooling or scanning.

State-of-the-Art Technology

Today, the commercial marketplace is dominated by portable, rugged, uncooled point & shoot and handheld cameras serving a wide range of qualitative and quantitative applications. Now Flir cameras feature extensive built-in measurement tools and data storage as well as reporting software. Highly sophisticated

Thermovision 661 at electrical substation inspection in 1969

Thermovision 680 performing building diagnostics in Swedish home early 1970s

imagers with cooled photodetector FPAs are also available in the industrial world, and are used particularly for gas detection and through-flame inspection as well as for specialized and high performance/high speed monitoring in certain R&D, science and automation settings [1].

Predictive Maintenance Applications

By far, predictive maintenance comprises the largest group of users of thermal imaging systems. Electricians use it to locate problems quickly, make timely repairs, prevent unscheduled shutdowns and improve facility safety. Mechanics use thermography devices to discover overheated bearings, linkages and other components before something interrupts operations or creates a hazard. Utility workers scan large areas and hundreds of connections efficiently to prevent unexpected outages and lost revenues. Roofing contractors discover leaks and other weaknesses so localized repairs can be made in time to prevent entire structure failure. And automation pros have learned that infrared cameras are effective tools for safety monitoring, process control and quality assurance imaging.

Yield Increase by Automation

Jason Styron, Flir's automation business development manager, recounted an example of how thermal imaging helped save the day for a roofing shingle manufacturer. According to Styron, "they were experiencing problems with boxes of laminated shingles showing up at job sites without the glue. Obviously not good for the roofers, the distributors nor the company's reputation." The problem, Styron says, stemmed from the inability to reliably tell when the clear glue supply had run out or become clogged. "Shingles rolling off the line at 700 feet per minute meant 50 boxes of defective product were already on their way to shipping before anyone noticed." With the addition of Flir remote monitoring, the operator sees the thermal image of the hot glue application and when it runs out. "Their next step is to add two Flir A310s to further automate the line so a set-point alarm will automatically trigger the system to come to an immediate halt in time to replenish the glue supply before it's empty." But, he adds, even now the company is benefitting by no longer shipping bad product and from cutting costly waste.

The Story Continues

With up to 307,200 points of calibrated, automatic, quantitative temperature measurements updated as many as 200 times per second, thermal imaging has proven itself to be an accurate way to observe production lines, sense flaws, perform critical vessel monitoring, and scrutinize automated operations. Newer Flir cameras for automation now also feature Ethernet TCP/IP and GigE Vision connectivity which makes interfacing with machine vision software easier and faster for integrators.

Infrared thermal imaging for industry has indeed come a long way over the past half-century and will be continued in the future by increasing the robustness and value of the thermography products.

Reference

[1] Kaplan, H., Scanlon, T., A thermographer's guide to infrared sensors, Tech. Rep., Honeyhill Technical Company and Flir Systems, 2001

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With Precision into the Race

Leica Absolute Tracker Gives Red Bull Racing Wings

Extreme probe lengths are no problem for the Leica T-Probe

Precision and reliability: These quality characteristics are required by every Formula 1 driver concerning his racing car. Even minimal deviations from the predetermined values could cost the victory and thus valuable points. That's why the Austrian owned, UK based Red Bull Racing Team uses laser trackers to measure precisely the racing car's components and to provide authoritative results.

In Formula 1, already hundredths of a second can decide about victory or defeat. In this elite class of motor sport, manufacturing tolerances are not a matter for discussion. Chris Charnely, Quality Manager at Red Bull Technology, the design and manufacturing part of Red Bull Racing, comes straight to the point: "We have no time for mistakes." The manufacture of Formula 1 cars demands precision and the highest standards in the development and manufacture of vehicle components. "Basically in our business we are continuously developing prototypes," says Charnley. During the racing season, the general shortage of time felt by Formula 1 racing teams builds up to extreme levels: Major modifications to the design to optimize the aerodynamics of the cars have to be completed in the period between two races, normally two weeks. "That's what you call high pressure," says Chris Charnley. "Working nights and weekends then becomes the rule. But we have a lot of fun doing it, especially when we see the success of our efforts in the race."

Asking for a "Leica-Check"

For the dimensional accuracy check, Red Bull Racing Team relies on Hexagon Metrology as an innovation partner. The Leica Absolute Tracker and the Leica T-Probe are used in various applications at the Milton Keynes factory. Quality Engineer Mike Hughes is frequently contacted by the designers when they wish to check the dimensional integrity of a new component. "They come to us and ask not just if we could measure the part – they ask us for a Leica-Check. The measurement results from our four Leica Geosystems Laser Trackers are reliable and authoritative. And word has got around."

Applying the "Legality Check"

Red Bull Technology measures the assembled racing cars as well as the individual components. Formula 1 is a sport, and sports have rules. The dimensions of the cars are strictly defined. "Legality checks" are all part of the routine before every grand prix. Compliance with maximum and minimum limits is confirmed quickly and easily with the Leica Absolute Tracker and the Leica T-Probe. Jon Roberts, Metrology Specialist, describes his experience: "There are many critical points on a Formula 1 car. We check the wings on the front and rear, the overall width of the vehicle, even the position of the pedals. Everything must be perfect down to the finest detail. With the Leica

Sales Manager Steve Shickell from Hexagon Metrology, Jon Roberts and Chris Charnley from Red Bull Technology are an experienced team

T-Probe, the difficult-to-access areas are simply more points to measure."

Branches Cooperate with Racing Team

Hexagon Metrology has already proved its worth as an innovation partner to Red Bull Racing. If the Formula 1 Team's metrology engineers have to carry out a difficult measurement, Hexagon Metrology technical service staff is there offering support. The advantage is that the Hexagon Metrology Regional Service Centre in Milton Keynes is only a few miles from the Red Bull Racing and Red Bull Technology headquarters. Even when the Formula 1 entourage sets off around the world, Red Bull Racing can depend on Hexagon Metrology's global presence. The Red Bull Racing measuring system usually stays at home. For an event in Spain however, the racing engineers urgently needed an accurate measuring machine, Hexagon Metrology in Barcelona quickly made a Leica Absolute Tracker available. Chris Charnley: "That's partnership. Our contacts at Hexagon Metrology are fully integrated into our team."

Also in the Wind Tunnel

The machinery park at Red Bull Technology includes several product generations of Leica Geosystems Laser Trackers. These systems are in use at the Red Bull Racing wind tunnel at Bedford. During the aerodynamic tests, the Laser Tracker continuously analyses how the model vehicle deforms in the wind. In addition, Red Bull Technology uses DEA coordinate measuring machines and a third-party CMM that has been modified with a Hexagon Metrology retrofit package.

Brilliant All-purpose Tool

Chris Charnley summarizes: "The Leica Absolute Tracker is a brilliant all-purpose tool and one of our best investments. The speed of measurements justifies the investment by the time saved on component measurement. Time after time, we are discovering more uses for it. Accuracy, portability and reliability inspire the team. The Leica Absolute Tracker has played an important role in our successes."

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A Perfect Profile

Optical Laser Sensors Measures Metal Strips' Thickness Profile

Metal strip is used as a raw material in the manufacture of numerous products and so is directly linked to the final quality of the end product. Therefore, metal strips need to be examined for compliance with quality criteria before further processing. In addition to its physical properties, the thickness profile of the metal strip is an important feature. There are many different approaches for measuring the thickness profile. This profile is captured over the length and the width by optical laser sensors regardless of alloy type.

During production, metal strips are rolled hot and cold whereby deviations from the target thickness may occur. Therefore, an exactly constant thickness of metal strips is difficult to reach. In order to optimise thickness profile, various methods are adopted such as roll cambering or support rollers. Important quality criteria of a metal strip are the thickness profile over the length and width, the geometry and documentation of measured values. Measuring systems that check the data and that provide correction variables for regulation are necessary to ensure the compliance with the quality criteria.

Thickness Measurement Methods

Conventional mechanical thickness measurement systems determine the thickness of the metal sheet via contact by a calliper-type arrangement at set measurement points. The values are then interpolated to provide what is only an approximate thickness measurement. This method is much too slow to yield an in-process detailed thickness profile across or down the length of the strip. Furthermore, such measurement methods are often affected by wear and are normally not automated and so are likely to interfere with the flow of production.

Alternatively, the thickness of metal sheets can be determined by using radiometric techniques. The radiation from an isotope source is dampened by the sheet metal. The remaining radiation is measured on the opposite side. The difference between the transmitted and the measured radiation is then converted to an area-weighted value and afterwards to a thickness measurement. However, this method very much depends on the alloy and condition of the metal sheet. Although such a thickness measurement provides sufficient information about the thickness profile for a known alloy, it requires complex, costly safety provisions due to the intensity of the radiation. Across three shifts, the cost of radiation protection, supervisors and continuous safety monitoring systems means that high variable costs are associated with these methods.

However, a solution is the use of the capacitive sensor technology. But one drawback of systems that use this technology is their relatively large spot size. The sensors measure over the complete face surface and so can only provide averaged thickness profile information around the frontal areas of the sensors. Better local resolution is required for the edges of the products.

The Alternative: Optical Laser Sensors

The use of optical laser sensors with radiometric and capacitive measuring techniques is a significant advancement in thickness inspection. Micro-Epsilon provides different variants for this. A simple C-clamp measuring device detects the thickness on a selectable track in the direction of production by using laser sensors and two-sided thickness measurement. Another variant operates using a closed O-frame. With this version, a sensor is placed on each side of the metal strip in an identical position to the other, which then move continuously at right angles to the production flow. The thickness profile over the complete width of the product can therefore be measured.

Robust Innovation

In the new high-end solution ScanControl, the sensor system also traverses

ScanControl Functionality

During a measurement, the reflected light of the laser line is recorded by a highly sensitive CMOS matrix which produces a precise image of the surface profile. Each change of the profile changes the displayed line and so forms a changed image on the matrix.

As the measurement object or scanner is usually moving, a 3D image of the object is produced by apposing the individual line profiles. In this way, a so-called point cloud is generated because the image is composed of many thousands of individual measurement points.

Coils are the raw material for many other products; an important quality criterion of the metal strip is the preferably constant thickness

Laser scanners provide very precise data, particularly for metals

along the measuring gap over the complete width of the strip. However, in contrast to conventional solutions, two laser line scanners are used. The new O-frame innovation from Micro-Epsilon Messtechnik uses specially adapted laser line scanners. In the case of a larger distance to the target and therefore a larger measuring gap, these scanners provide higher precision thickness measurements compared to laser point sensors. With a measuring gap of 200 mm, the system is able to handle large fluctuations in strip guidance and is extremely robust. An open structure at the bottom protects the system. So, scale and dirt simply drop through the system. Vibration of the metal strip or curved/bent strip ends are always a risk for the installed sensor system and so additional mechanical protection is provided to completely safeguard the measuring system.

Laser Line instead of Laser Point Sensors

The use of profile sensors instead of point sensors increases the density of profile information, enabling much better measurements on many different strip materials, regardless of alloy type. The measurement accuracy is also significantly improved by using laser line scanners rather than point lasers; an accuracy of 0.01 mm for a maximum strip width of 4 m is achieved with laser line scanners. High-tech light barriers support the profile sensors. They take over the task of width measurement and if necessary the edge detection of individual strips after splitting. All measured data can be used for documentation of the metal strip. The "thickness" and "profile" measured data are assigned online to a precise position on the strip. The system is used in service centres for flat metal strips and after the separation of the coils into individual metal strips.

The system is considered to be a high-end solution for the measurement of metal strip geometry. Popular conventional measurement systems have been effectively substituted with this system. The return on investment associated with laser scanner measurement comes from the more detailed knowledge of real strip tolerances, including the fact that each individual strip is documented and traceable for the end customer.

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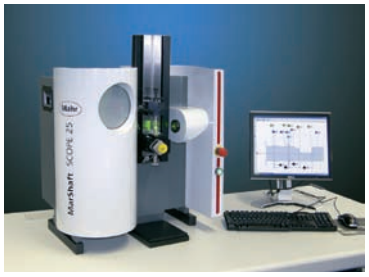
Non-contact Measurement of Small Shafts

Mahr's MarShaft Scope 25 is an optical shaft measuring instrument for small, rotationally symmetrical workpieces – for example turned parts, plug connections and precision parts. Production plants can check all the relevant features of workpieces of up to 200 mm in length and 25 mm in diameter. Measurements can be performed quickly in just a few steps: The user clamps the workpiece between the two centering pins and finds the relevant measuring positions in a shadow image. He then starts the automatic measurement by the line scanning camera via the measuring computer. The main advantage of this automated quality assurance is that the user cannot influence or accidentally distort the measuring results. The MarShaft Scope 25 offers high precision thanks to the intelligent combination of various measuring sensors such as a profile projector and measuring microscope.



Mahr GmbH
Tel.: +49 551 70730 · info@mahr.de · www.mahr.com

High Precision Measurement in 3D

In order to provide the many advantages of the confocal chromatic imaging, Stil has started marketing a new range of sensors: Stil-Initial. These sensors will allow customers to access high precision measurement in 3D. Stil-Initial controller's main characteristics are high resolution, a maximum acquisition rate of 2,000 Hz, synchronization signals with one input and one output and a serial RS232 and USB 2.0 interface. Each reference of the new range Stil-Initial is composed of full measuring equipment which contains of the controller Stil-Initial, an optical pen, a linking optical fiber, a kit of cables (supplying wire, series, USB) and a USB key with image processing tools. There are three different configurations with a measuring range of 0.4 mm, 4 mm and 12 mm. This range is from now on available in direct purchase at Stil.

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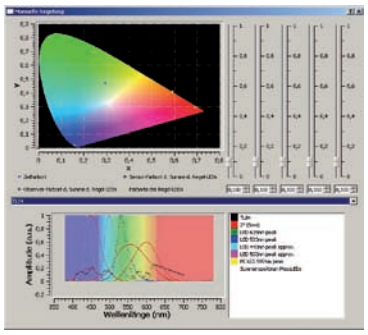
Simulation of Semiconductor Sensors

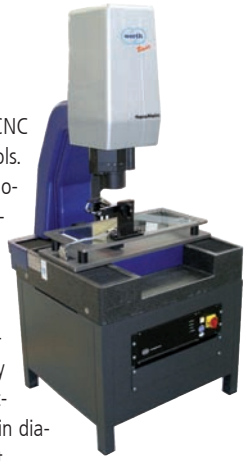
Mazet, a development and manufacturing service provider offers a tool for the simulation of compact spectral-selective semiconductor sensors for precise inline measurements, available immediately. The system is simulated during the feasibility study and optimized accordingly to the requirements presented. The simulation software enables choosing the right sensor, as well as the optimal combination of filters and illumination. With the simulation application Mazet provides different sensor models for color measurement to be able to cover a variety of precision requirements while specifically containing cost. The sensor models include RGB and XYZ sensors for simple teaching, XYZ and multi-range sensors for absolute color measurements and and even multi-range sensors for radiometric measurements.



MAZeT GmbH
Tel.: +49 3641 2809 0 · sales@mazet.de · www.mazet.de

Inline Tool Inspection

With the NanoMatic, the company Tool MT presents a CNC measuring machine for rapid production monitoring of tools. With a design that dampens vibration, and special tool positioning on a sapphire-coated V-groove, high-precision tool measurements are possible without run out or pendulum errors. Optimal detection of cutting edges at high resolution is achieved with motorized zoom optics. In addition to fully automatic sample testing during series production, the measuring machine can also be used for 100% inspection, due to very fast measurement speed. Tools such as mills, drills, form cutters, step tools, and reamers can be measured up to 20 mm in diameter. Larger measurement ranges are available upon request.



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High-speed Video Systems for Extended Recording Times

With the new MotionBlitz LTR1 (long time recording), Mikrotron offers a complete high-speed video system for extended recording times. Featuring a light-sensitive, compact camera from the EoSens series, this system can produce video recordings at 506 fps up to 165 minutes in duration at full 1,280 x 1,024 pixel resolution. And recordings can be made at rates of up to 30,000 fps with the integrated ROI (region of interest) function. In addition, thanks to the integrated Full Camera Link interface, images from the camera can be saved on a PC's hard drive in real-time using a ring buffer. The LTR1 comes as a ready-to-use, complete system including a 19" rack PC, compact 1.3 megapixel EoSens-series high-speed CMOS digital camera, Camera Link frame grabber, Camera Link cable, and control software.

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Digital Camera with Scientific CMOS Sensor

Hamamatsu introduces the new Orca-Flash2.8, a high-sensitivity digital camera based on a unique 2.8 megapixel next-generation scientific CMOS image sensor. Designed for low-light imaging at high frame rates, this new camera combines high resolution, high sensitivity, high speed and low noise. 45 fps are output in full resolution, making it ideal for fast, low-intensity imaging. The Orca-Flash2.8 can achieve a maximum speed of 1,273 fps in sub-array mode. The cooled FL-280 sensor's design keeps readout noise minimal at three electrons, even with very fast readout speeds. The camera's 12-bit output interfaces with a PC via a standard CameraLink base framegrabber. The camera is suitable for a wide variety of applications such as life-science microscopy, industrial imaging and sensitive analytical measurement.

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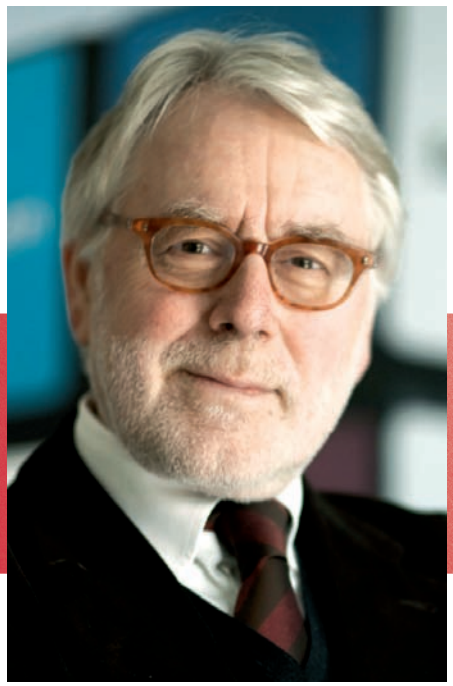

Visiona

Interview with Wilhelm Stemmer, Managing Director of Stemmer Imaging

INSPECT: Mr. Stemmer, you founded your company, which today is Europe's largest trading house for imaging technology, as early as 1987. Was image processing your original focus?

W. Stemmer: The foundation of the Stemmer Imaging GmbH in 1987 marked the official start of our focus towards imaging and machine vision. The corner stone, however, was built back in 1973: Stemmer Elektronik GmbH was involved in production and sales of components and systems for industrial automation in the areas of data acquisition, imaging and computer communication. In 1975 the field of industrial image processing developed very positively which convinced us to establish the Stemmer Imaging GmbH in 1987, a company that fully concentrated on imaging and machine vision. The success of today's European combined company is based on this foundation stone.

What have been the highlights of machine vision during the last 10 years from your personal point of view? What has really made a difference for the technology itself, the industry and the customers? What major steps can we expect in the future?

W. Stemmer: Imaging is a very innovative technology and the companies involved have accomplished a lot of interesting developments in the last years. This is the case for components, for example cameras, that offer far better resolution and higher speed thanks to improved sensors. This also results in performance increases for other components. Today more precise high resolution lenses, more powerful illumination and image acquisition technologies are available, compared to 10 years ago. Of course computers, interfaces and software algorithms also offer the required performance increase.

An important trend to be seen in the past years is the fact that the use of vision systems became easier so that a dedicated vision specialist is no longer required for the set-up. Considering the lack of specialists and the fact that more and more end users start using imaging solutions, the continuation of this trend is very important for our market.

It is very hard to emphasize single highlights out of the multitude of developments that have taken place in the last 10 years, but if machine vision succeeds in keeping up the innovation strength, it will establish itself as the perfect tool for quality control in many different applications and markets in the future.

The roots for machine vision in Germany are definitely in the area of industrial applications. Do you see this still as the predominant application area for vision systems and technologies today?

W. Stemmer: At least for us at Stemmer Imaging the most important and biggest part of applications are still to be found in the industrial area. However, we solve more and more very interesting applications in non-industrial markets using partly the same imaging components that have proven themselves in the industrial field. This expansion of application areas also reflects the same findings of surveys done by the VDMA over the last few years. Intelligent traffic systems, security or sports are the areas with the largest growth potential in the non-industrial field. The use of imaging and machine vision outside of the industrial world will for sure increase considerably.

How has the role of the distributor changed during the last two decades? What do your customers expect from you today that they cannot get direct from the supplier himself?

W. Stemmer: From the beginning we considered our business model to be far more than pure distribution. Of course we make our money selling imaging components, but our customers benefit considerably from the value add that we offer. This starts with selection of the technically and commercially most suitable combination of components to solve the customers application. Therefore it is more and more important to understand the requirements of special customers in different markets.

Our concept has for some years now also been based on our own developments. As far as hardware is concerned

we concentrate on the "little helpers," small auxiliaries that are often the key to a successful application. In addition we sell our own software Common Vision Blox worldwide through an international distribution network. An extensive support service that helps our customers with all questions in the field of imaging completes our offering. Those services go far beyond what a manufacturer can offer. Our customers will profit from this strategy in all areas also in the future.

Further changes that took place during the last years relate to the reduced exclusivity of partnerships and the increased European presence: Besides the pure technical aspects, our international customers require a reliable, cross-national partner. With a presence in Germany, Great Britain, France and Switzerland Stemmer Imaging is able to offer a level of security that is unique in the area of imaging.

Today, Stemmer Imaging has around 130 employees in four European locations. You yourself are intrinsically linked not only to this success but also to the history of European machine vision. What advice can you give young entrepreneurs striving for such success?

W. Stemmer: Founding a company back in 1973 cannot be compared to present times. However, there are always some factors that are valid for entrepreneurs independently of the area of business. The company needs to generate sufficient turnover to earn a gross profit that is higher than pure cost recovery. The resulting profit should be invested in the growth of the company. This advice is given by a Bavarian Swabian (an ethnic group in Germany that is known for being very economic with anything they do), who never accessed any bank credit during his whole entrepreneurship. With a pioneering idea, a lucky hand for responsible employees, strong effort, patience and attention on cost and profit a sustained success is also possible today.

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Preview

Look ahead to our special on "Trends & Technologies" and the following topics of our next issue:

- Trade show pre-view Vision Stuttgart
- Machine Vision Basics: Camera Sensitivity
- Software Simulation in Machine Vision
- 3D Technologies from Dentist to Machine Builder
- Texture-based Object Recognition
- Fast CMOS Cameras with Global Shutter
- GigE Line Scan Cameras for Recycling
- Illumination for Machine Vision
- Trade Show Survey on Cameras and Software
- Sorting with integrated Surface Inspection, Quality Control of Solar Modules
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and much more

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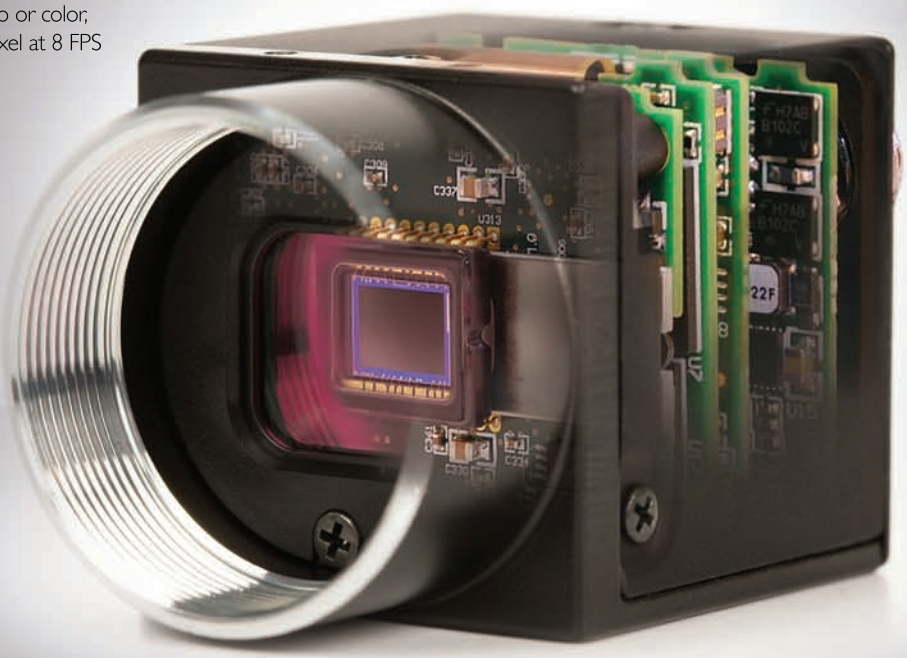

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