01:06

# Laser Community

THE LASER MAGAZINE FROM TRUMPF

WWW.TRUMPF-LASER.COM

## Visionary

What Adolf Giesen does with the disk

## Speed!

Why scanner welding revolutionizes the joining technology

# Project: Future

Creative, up-and-coming designers like Mario Poess and Chen Zhihong give professionals a hand → S. 23

**PLUS: Laser Factbook**

Detachable Pocket Guide.

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# 01:2006

## *IMPRINT*

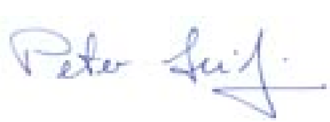
*Laser Community* — the laser magazine from TRUMPF: That's the name of the volume that you now hold in your hands. It's appropriate in the first issue to express what we have in mind with the magazine and why we offer the laser world another publication.

Martin Luther wrote about the "freedom of a Christian", beginning with two sentences that are apparently contradictory: "A Christian is a free man over all things and is subject to no one. A Christian is a servant to all things and subject to everyone." Please forgive me for exploiting this text in an almost blasphemous way, but it appeals to me for our laser magazine: *Laser Community* is an independent volume and subject to no one. *Laser Community* is a servant to all things and subject to TRUMPF.

# We need an open discussion!

It is our goal to overcome this contradiction. On the one hand, it is clear that *Laser Community*, as the laser magazine from TRUMPF, represents viewpoints and opinions from our company. At the same time, however, we intend to use our magazine to make an authentic contribution to our community, for those who work with lasers and their applications. We want to do this by providing information about things occurring outside of TRUMPF, by describing products and technologies that we do not offer, and by printing opinions and viewpoints from people who are not affiliated with TRUMPF.

We will work hard to solve this paradox. Keep an eye on how well we do and please offer criticism if you feel that we are missing our goal. Because we need an open discussion! An authentic exchange of information can only take place within an open discussion, and only within an open discussion can new thoughts and innovations occur. This is the very air that our industry breathes. In this spirit, I hope you greatly enjoy *Laser Community* and that it provides some stimulus for new ideas!



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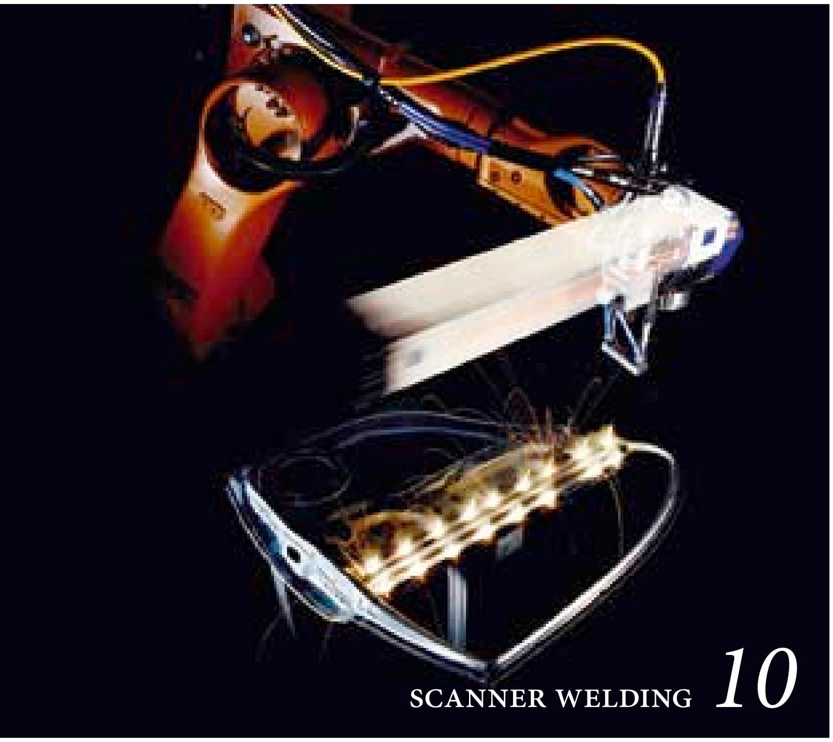


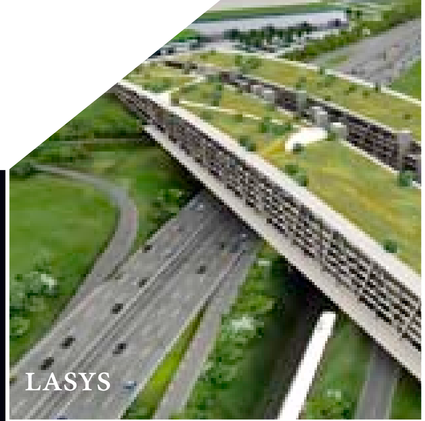


06-09 WHO-WHAT-WHERE



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## *COMMUNITY*

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## *TOPIC*

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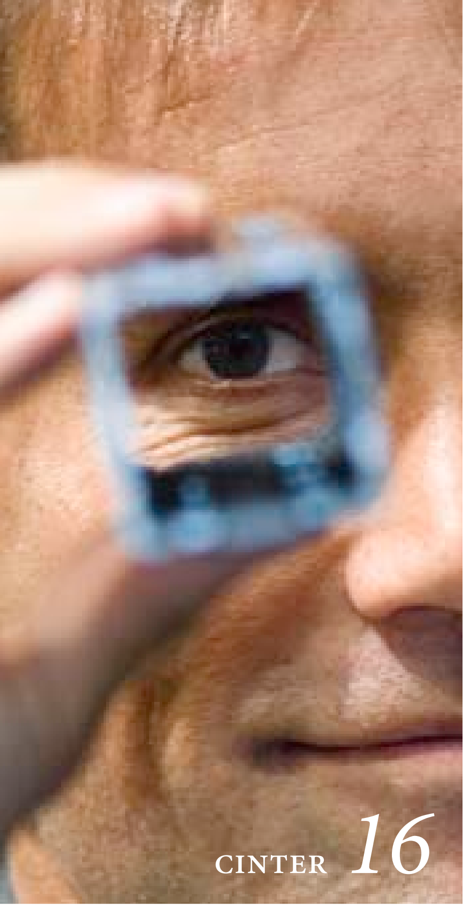
Professor Joachim Milberg calls for a magic circle connecting research and industry. PAGE 15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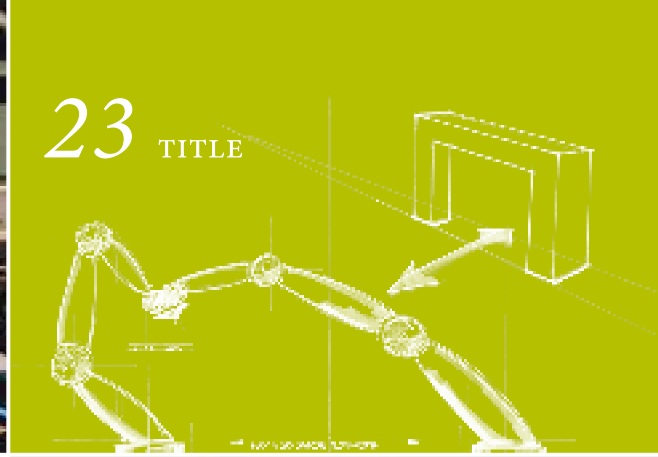
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TRACEABILITY 20


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2006

# SPOT

### --- LASER NETWORK

In the USA, the **Industrial Laser Group** joined the Technical Community Network of the **Society of Manufacturing Engineers (SME)**. The association's goal is to advance the use of laser technology in North America. *www.sme.org*

### --- WORTH KNOWING

Marking, cutting, welding and more — a light beam conquers industrial production: The new TRUMPF Book **The Laser as a Tool** is a must for the community. The English version follows the German version in spring of 2007. *www.trumpf.com/werkzeug-laser*

### --- DIAMOND SAW

**Sarin Technologies Ltd.**, an Israeli specialist in gem processing, offers a laser system for cutting and processing diamonds. The advantages of the laser system are minimal breakage and reduced weight loss. *www.sarin.com*

### --- FOCUSSING

**Coherent Inc.** intends to purchase **Excel Technology Inc.** for US-dollar 376 million. Approval of the deal is expected by end of July. Excel CEO **Antoine Dominic** believes in a faster product and application development as a result. *www.coherent.com, www.exeltechinc.com*

### --- WEAR-PROOF

The German laser repair welding specialist **Stehle Laser-Schweisstechnik GmbH** is offering cobalt-base alloy filler materials as thin rods. Due to their brittleness, Stellites are not yet available as wires. *www.laser-welding.net*

### --- CONNECTION

The American **Fabricators & Manufacturers Association (FMA)** and the **Laser Institute of America (LIA)** together acquired the **ALAW (Automotive Laser Application Workshop)** from its founder **Frank DiPietro**. *www.fmanet.org*

### --- POWER

The German company **JENOPTIK Laserdiode GmbH** presented high-powered diode lasers with an output power of half a kilowatt per bar at **Photonics West** in January in San Jose, USA. *www.jold.com*


*EU Commissioner Viviane Reding*

# Europe Strengthens Photonics

## Technology Platform Photonics21 points the way into the future

Since December 2005, laser users, manufacturers and researchers from 27 European countries have focused their energies in the **European Technology Platform Photonics21**. Their goal: to better coordinate research activities for optical technologies, thereby enhancing Europe's industrial profile. The research agenda “Towards a Bright Future for Europe” summarizes the principle statements of Photonics21. **EU Commissioner Viviane Reding**, who is responsible for research subsidy proposals to the commission, received the agenda on April 4, 2006 in Strasbourg from **Alexander von Witzleben**, President of Photonics21 and CEO of **JENOPTIK AG**. Many branches of industry profit from the advances in photonics, such as electronics, aerospace and automotive industries. *www.photonics21.org*

# Lasers in China

A laser institute for an elite university: At the end of March, prominent Chinese and German officials celebrated the opening of the 3,000 square-meter Laser Processing Laboratory at the **Shanghai Jiaotong University**. The festivities celebrated the inauguration of the laser technology research and education institute as part of the German-Chinese **CHINLAS** project. The two countries are investing more than 4 million Euros into the program. For its first project, the institute received a 15 kilowatt $CO_2$ laser system for heavy duty machine construction. The coordinator of the German partners is the **Technologiebroker Bremen GmbH**. The **Bremen Institut für angewandte Strahltechnik (BIAS)** represents the research portion.

*www.sjtu.edu.cn/english, www.bias.de*

*Prof. Dr. Shen Weiping (left), Chairman of the Chinese consortium and Dr. Harald Kohn, Chairman of the German consortium at the opening of the new laser institute.*

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Beginning in 2008, the cross-industry laser meeting place for users and system providers: The new Stuttgart trade show at the airport.

Sandy Zorn is planning LASYS, the new laser system trade show.

# "The LASYS is the key to markets"

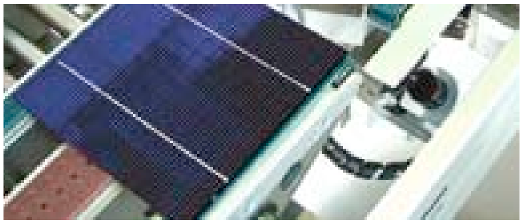
The meeting place for laser users starting in 2008: Team leader Sandy Zorn explains what LASYS will provide.

**Why was this trade show necessary?**
LASYS is the only trade show for laser machining that showcases both systems and processes, and is not limited to any one material or industry. Providers have the advantage of meeting customers with any application background within the investment goods industry at one trade show. The visitors, in turn, find a compact presentation of all laser machining systems and processes serving a range of materials. As a result, LASYS is a one-stop trade show for all participants.

**Why should the laser world come to Stuttgart?**
The region has an unparalleled concentration of companies from first-tier industries. That is, the automotive and supplier industry, machine systems engineering, the metal machining and processing industry, medical technology, as well as precision engineering and technology. And in June 2007, the new trade show will open its doors at the airport in Stuttgart. So LASYS is right in the middle of the action.

**Could you give us a sneak preview?**
Absolutely. The "Stuttgarter Lasertage (SLT)", which was rescheduled by a half-year for the benefit of LASYS. But it's still too early for anything more.

**Contact:** Sandy Zorn, Phone +49 (0) 711 2589 – 374, sandy.zorn@messe-stuttgart.de, www.messe-stuttgart.de/lasys



Solar cell production clocked in seconds.

# Laser Integration

That the sun can create power is nothing new. But the inline system from **Manz Automation AG** for edge isolation of solar cells is. The company developed the new system in cooperation with the solar cell manufacturer **Deutsche Cell GmbH** and the **Fraunhofer Institute for Solar Energy Systems (ISE)**. The advantages of the new system: It processes solar cells even faster than ever. It insulates the edges of the cells using a short-pulsed solid-state laser, without interrupting the production flow, in a 1.5 second cycle. And it is environmentally friendly. In contrast to traditional processes, the new system requires no highly toxic chemicals for the isolation of the edges.

*www.manz-automation.com*

Richard Chow-Wah, Vice President of DaimlerChrysler Powertrain Manufacturing hands the Laser Champion Award to Frank DiPietro.

# Award for Lifetime Laser Achievements

Untiring work for the future of laser technology: In April 2006, **Frank DiPietro** was awarded the first **Laser Champion Award**. The **TRUMPF Laser Technology Center** in Michigan gives the prize to individuals who champion the use of laser technology at their companies. DiPietro worked for more than 45 years in automated systems, tooling, robotics, and laser systems in **General Motors Corporation's** automotive operations.

Pictures: BIAS, European Commission, Manz Automation AG, Messe Stuttgart, TRUMPF Group

## NETWORK NODE

### LASER INSTITUTE OF AMERICA (LIA)

For nearly 40 years, the Laser Institute of America has been dedicated to the development, application and safety of laser technology. The founders, all users of laser technology, believed that it was as important to share new ideas as to develop them. To this day, the emphasis is on the network aspect: The bandwidth of the Institute ranges from courses on laser safety — no institution worldwide trains more safety officers than the LIA — to conferences such as the International Congress on Applications of Lasers and Electro-Optics (ICALEO). Members have the opportunity to exchange information online with other laser users worldwide. Perhaps the chat is already about the next prize winner of the Arthur L. Schawlow Award. The prize is awarded by the LIA for distinguished contributions to applications of lasers in science, industry or education.

*www.laserinstitute.org*

## *Quantum Leaps*


**1985**

# Stuttgart Draws Fibers

The IFSW receives a fiber production for its research

*On the way to more efficient transport fibers: Burners in a fiber drawing tower*

Nearly 2 million Euros for the **Institut für Strahlwerkzeuge (IFSW)** at the **Universität Stuttgart**: What is it that the university quality improvement program of the state of Baden-Württemberg and the **Deutsche Forschungsgemeinschaft (DFG)** seek to advance? The answer: Today's optical fibers cannot guide the high-power laser beams of tomorrow. This is why the IFSW wants to develop fibers that can withstand enormous power densities and at the same time provide robust beam guidance properties. The IFSW will invest the grant money into a system for fiber preforming and a drawing tower. The researchers affiliated with **Professor Thomas Graf** will offer the use of their fiber production system to external research institutions as well. The system should be installed by the end of 2006.

**Contact:**

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E-mail: voss@ifsw.uni-stuttgart.de

# Winning Ideas

Zukunftspreis for Professor Jeffrey Kimble

*The first winner of the Berthold Leibinger Zukunftspreis: Professor H. Jeffrey Kimble*

Before **Professor Jeffrey Kimble** from the **California Institute of Technology**, no one had received it: the Berthold Leibinger Zukunftspreis. On July 3, the **Berthold Leibinger Stiftung** awarded for the first time its recognition of forward-looking milestones in laser technology. Kimble's experiments on resonator quantum electrodynamics are such a milestone as judged by the jury. The winners of the 2006 Berthold Leibinger Innovationspreis have also been named. First prize went to **Dr. Karin and Raimund Schütze,the founders of P.A.L.M. Microlaser Technologies GmbH** in Bernried, Germany, for their laser microtool used to obtain individual cells. Since the end of 2004 P.A.L.M. is part of the **Carl Zeiss AG. Professor Ian Walmsley** from **Oxford University** received second prize for the SPIDER measurement method to characterize ultrashort laser pulses. **Dr. Michael Mei** and **Dr. Ronald Holzwarth**, founders of **MenloSystems GmbH** in Martinsried near Munich were awarded third prize for their development of compact laser systems using optical frequency comb technology. The jury made its decision in March after all nominees had presented their work.

*www.leibinger-stiftung.de*

*Hans Hornig, BMW Group: "Participating in the EALA is worth it …"*

# Auto meets Laser

The automotive laser community meets annually at **European Automotive Laser Application** (EALA). We asked **Hans Hornig**, Director of Welding and Joining Technology at the **BMW Group**, what makes this conference so special.

**Why is it worth to participate as a visitor?**
Quite simply because of the international character. The event organizers put forth a great effort in this area and each year they invite experts from around the world, which brings new perspectives and insights.

**What do you personally like about the EALA?**
The rich mixture of the participants. Laser and systems manufacturers are as equally well represented as quality assurance colleagues or laser technology users — mostly from the automotive and supplier industries. This variety provides a space for interesting dialogs and discussions.

## A PLACE TO GO

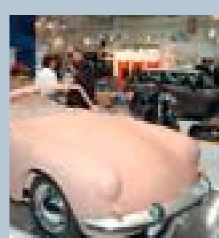
# ICALEO 2006

Starting October 30th, 2006 in Scotsdale, Arizona in the USA, the International Congress on Applications of Lasers & Electro-Optics (ICALEO) celebrates 25 years of networking and knowledge. The conference is where international researchers and end users meet to review the state-of-the-art in laser materials processing and forecast the future. One high-light is the presentation of the Arthur L. Schawlow Award.

# CALENDAR

*EuroBLECH: International Sheet Metal Working Technology Exhibition: www.euro-blech.com*


*ComPaMED: International Trade Fair Components, Parts and Raw Materials for Medical Manufacturing: www.compamed.com*



*EuroMold: World Fair for Moldmaking and Tooling, Design and Application Development: www.euromold.com*

**IMTS**
*Sep. 6 – 13, 2006, Chicago, IL, USA*
*International Manufacturing Technology Show: www.imts.com*

**AMB**
*Sep. 19 – 23, 2006, Stuttgart, Germany*
*International exhibition for metalworking: www.messe-stuttgart.de/amb*

**MICRONORA**
*Sep. 26 – 29, 2006, Besançon, France*
*International microtechnology trade fair: www.micronora.com*

**FAKUMA**
*Oct. 17 – 21, 2006, Friedrichshafen, Germany*
*International trade fair for plastics processing: www.fakuma-messe.de*

**EUROBLECH**
*Oct. 24 – 28, 2006, Hannover, Germany*

**MD&M MINNEAPOLIS EXPOSITION**
*Oct. 25 – 26, 2006, Minneapolis, MN, USA*
*Medical Design & Manufacturing: www.devicelink.com/expo/minn05*

**ICALEO**
*Oct. 30 – Nov. 2, 2006, Scotsdale, AZ, USA*
*International Congress on Applications of Lasers & Electro-Optics: www.icaleo.org*

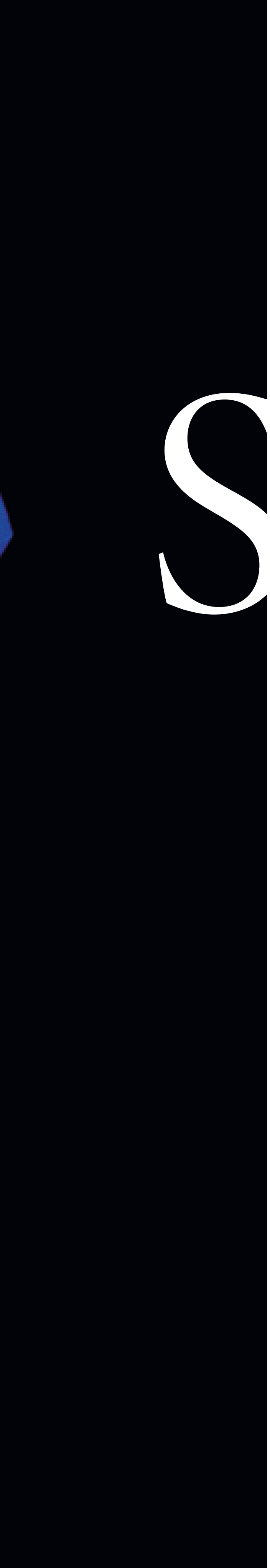
**FABTECH INTERNATIONAL & AWS WELDING SHOW**
*Oct. 31 – Nov. 2, 2006, Atlanta, GA, USA*
*North America's largest metal forming, fabricating, and welding exposition and conference: www.fmafabtech.com*

**PRODEX**
*Nov. 14 – 18, 2006, Basel, Switzerland*
*International exhibition for machine tools: www.prodex.ch*

**COMPAMED**
*Nov. 15 – 17, 2006, Düsseldorf, Germany*

**EUROMOLD**
*Nov. 29 – Dec. 2, 2006, Frankfurt, Germany*

*Pictures: Berthold Leibinger Stiftung, Deutsche Messe AG, LIA, Messe Düsseldorf, Messe Frankfurt GmbH, NEXTROM*





# Speed!

**Light in motion: A small box, connected to a yellow cable and moved by a robot's hand, throws flashes of light onto a car body part. A snap-shot of Robscan.**

*The robot guides the laser tool while the scanner mirrors guide the beam: the perfect symbiosis. Light jumps from welding spot to welding spot in fractions of a second.*

Tested for a long time — and now making its way to volume production: In 2007, DaimlerChrysler will introduce into production a new laser welding process using scanner optics. The improved beam guidance will help this technology capture additional market share for car body construction. The welding-on-the-fly technology (DaimlerChrysler internally: Robscan) seems to be an inspired discovery — faster, more precise, and more economical. The laser beam is generated far from the welding cell and can be directed into as many as six different exits, based on need. The light bundle is then guided through a laser light cable (up to 100 meters long) to the individual welding robots. In principle, the robot holds the flexible laser light cable in its "hand." However, instead of always positioning the "laser tool" at the end of the laser light cable precisely above the welding spot, the robot continuously moves at a relatively high distance over the workpiece.

**The Highlight:** A scanner head is installed at the exit end of the laser light cable. From there, two adjustable mirrors direct the bundled light to the work site in a flash. The laser beam jumps from one welding spot to the other in fractions of a second. There is no need for the robot arm to start and stop at every welding spot, a comparatively slow process which happens in spot welding. The laser beam is precisely diverted using scanner optics. "In tests that approximate volume production, we have reduced the production times by almost 80 percent compared to traditional resistance spot welding," explains Holger Schubert, project manager of Robscan in Production and Materials Technology at DaimlerChrysler in Sindelfingen, Germany. →

Photo: DaimlerChrysler

*Substantial laser welding is already applied in the production of the new Mercedes Benz S-Class. In even larger dimension DaimlerChrysler will use Robscan starting in 2007.*

## "Given the secondary effects the overall cost analysis favours Robscan over traditional spot welding."

Five years ago, DaimlerChrysler corporate researchers in Ulm recognized the technology's possibilities and, working in collaboration with TRUMPF, established the viability of the welding-on-the-fly technology principal. The experts of corporate research and the Sindelfingen based department of Production and Materials Technology then finished the development process of both the system as well as the process for volume production.

*The scanner optics only need access from one side, making the process ideal for constructions with closed cross-section.*

**Into series production:** Beginning in 2007, DaimlerChrysler will weld various structural components and exterior body sheets for a new model using Robscan. Further details on its use in volume production is not yet disclosed. In addition to the processing speed, which is up to ten times faster, the designers and production specialists particularly value the greater flexibility in body construction. Welding patterns are possible in any shape — for example, as a circle or a staple, in an S-shape or an interrupted seam. The welding patterns, precisely adapted to the load, do not require flanges as large as are necessary for conventional spot welding. The components are therefore smaller, lighter, and more cost-effective.

In addition, accessibility from only one side is adequate for laser scanner welding. Traditional welding guns always had to make the welding spot from both sides. Thus the laser offers an opportunity to employ profiles and tubes, which are due to the closed cross-section more rigid than formed sheets and also more cost effective. This provides designers with new ways to create even lighter and more rigid vehicles. But it presumes that they construct the bodies from the bottom up using laser technology. Holger Schubert continues on this thought: "If all future models are constructed consistently according to the requirements of Robscan, we will be using it to weld many more components." Preferred those with many welding patterns on one level. In these cases the laser can create many welding connections in one operation very quickly without any need for the time-consuming process of repositioning the robot with the scanner optics relative to the workpiece.

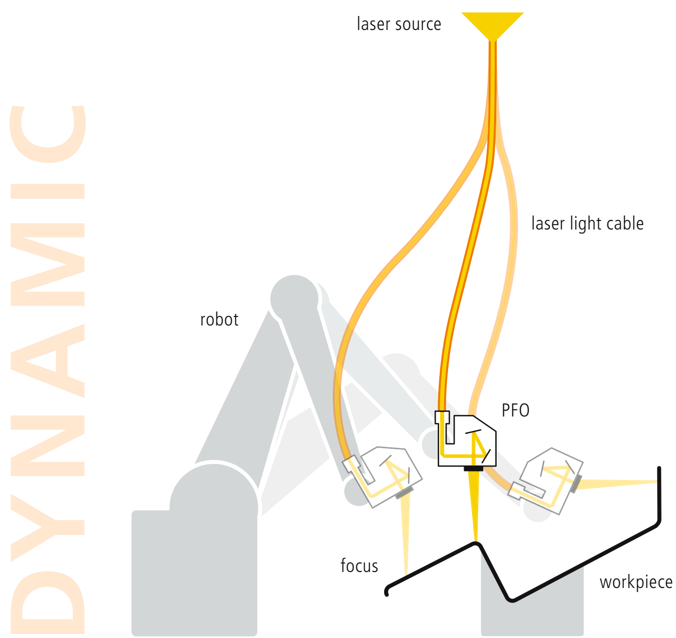
**But Robscan can do even more:** For example, it performs multiple welding processes in only one processing station where multiple stages are needed in traditional welding. This in turn saves DaimlerChrysler no insignificant amount of investment costs for the systems since they require a lot fewer robots and clamping devices. And the welding-on-the-fly production cells take up much less space. Finally, the actual productive on-times of the 4 kilowatt disk lasers are very high because there is no time-wasting positioning.

The lower number of clamping and positioning operations has even more advantages. All components extremely come up to the requested dimensions because many more welding patterns are applied during each clamping operation leaving fewer opportunities for distortion. Speaking of distortion, in comparison to traditional welding procedures, laser welding imparts less heat and mechanical loads to the components making for less distortion.

**And what about quality assurance?** "Already taken care of," says Schubert by way of assuaging any doubters. "We have already converted an assembly from the S-Class predecessor for production by Robscan, the so-called rear end center assembly, consisting of three individual parts." The readyness for series production has been proven clearly. Other field tests on exemplary parts of different models at various production sites confirm this. →

# ONE PROCESS — TWO CONCEPTS

Whether a laser light show, laser marking or scanner welding, the principal is always the same: In all three applications, laser light is diverted with scanner mirrors. Of course, the implementation of a scanner welding system needs to be adapted to the high output levels and workspace required. Two different system concepts for scanner laser welding demonstrate their abilities in industrial use. They are based either on the flexibility of the solid-state laser or the performance of the $CO_2$ laser.




**System:** **Robot-guided scanner welding optics PFO**
**Beam source:** **Disk laser**

**The principle:**
A robot carries the scanner optics. This approach is possible because the light from solid-state lasers can be guided through flexible laser light cables — from the laser beam source directly to the scanner optics on the robot arm. While the robot moves over the workpiece with spacious motions, the scanner optics is responsible for the exact positioning of the laser beam. The scanner optics offer a high positioning speed and flexibility of the seam geometry within the scanner field. And with a connection to the robot, free movement and orientation of the scanner field are possible in its three-dimensional workspace. The laser beam is positioned on-the-fly, that is, as a superposition of the continuous robot motion and the superfast deflection by the mirrors. The combination of PFO, robot, and disk laser is particularly well-suited for integration in production lines.

**System:** **Stationary one-mirror scanner**
**Beam source:** **$CO_2$ laser**

**The principle:**
The workpieces are positioned in the work field under the stationary scanner optics. The $CO_2$ scanner systems with one mirror optics are characterized by a massive workspace: The diameter of the cone-shaped work area is 1,500 millimeters at the base with a height of 500 millimeter. Within this space, the focus of the laser beam jumps at a speed of almost 1,000 meters per minute. Welding with low-distortion strategies is thus possible by locating the seams not one after the other along a path but rather distributed over the entire component. The heat input can therefore be distributed evenly. The open design of the stationary scanner system with integrated $CO_2$ laser allows for integrated multi-station operation. The scanner optics can be moved over a travel path of 2,400 millimeters along the bridge. With the work range of 3,900 millimeters it serves up to four stations. Primary areas of use are isolated stations for subassemblies outside the production line.

STATIONARY

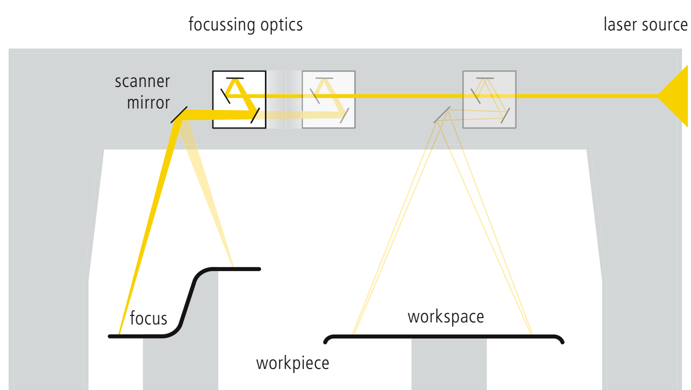



Illustration: Gernot Walter

For the production startup in 2007, disk lasers will account for prominent part of all welding in the body. DaimlerChrysler in Sindelfingen and other locations within its global production network have therefore installed the according number of robscan systems. Up to six robots will be attached to one beam source, supplied with energy-rich light using laser light cables that are each up to 100 meters long. If needed, the connection of laser sources and robots allows a quick switch from one beam source to another without new cabling or programming. With the specially developed Master-PC which connects the single components (laser source, scanner optics and robot) DaimlerChrysler reaches highest flexibility. Furthermore, the Master-PC allows not only the interchangeability of the components but also a standardized and most flexible programming.

"We're convinced that even more assemblies can be produced economically using Robscan."

**A small downer** on the welding-on-the-fly systems at DaimlerChrysler: Their investment costs are currently only comparable to those of conventional spot welding systems. "But given the secondary effects such as faster welding processes, smaller space requirements and future improvements in component and vehicle properties, the overall cost analysis is favorable," says Schubert, looking on the bright side. "We're convinced that even more assemblies can be produced economically using Robscan." Although welding-on-the-fly will not completely replace conventional spot welding in the foreseeable future, at DaimlerChrysler it will develop into a crucial body-in-white production technology. ■

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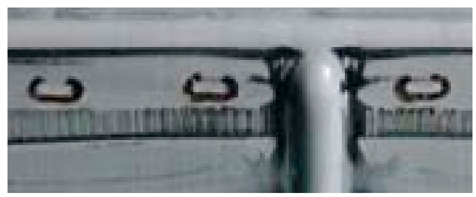
*Showcasing what scanner welding can do: close contours on the front plate of an exhaust heat exchanger, insert-welded bolts or large numbers of distributed seams e.g. at the hat rack of a car.*

# That can be done

## What scanner welding with high-power lasers can do and which applications are worth thinking about.

Scanner welding is a very fast and dynamic joining technology that shows its strengths in more than just car making. In general, it is an interesting option for quantities greater than 100,000 units per year or when many welding operations are acquired for each component. The time saved by moving faster from one welding spot to the other can shorten the processing time by up to three quarters. A scanner welding station can therefore replace several conventional welding stations, which not only saves space but also, as a result of the laser's basic flexibility, allows various components to be welded in one station.



*Staple-shaped seams*

*Two principle fields of applications for scanner welding described in brief:*

### High positioning speed

Scanner welding illuminates nonproductive downtime caused by positioning the welding tool. This advantage becomes more significant as the distances between the welding spots become greater and the number of weld spots per component increases. A positive side effect: Without losing any time, the seam sequence can be selected individually so that the heat input is evenly distributed. Specific examples beyond the car body where these advantages can be exploited include frames for seat rests, fans or even guide rails of ovens. They are of general interest for sheet metal assemblies, housings, patchwork sheets and the like. If there are many welding spots on a component produced in a high quantity, then laser scanner welding technology is definitely worth a look.

### Unlimited dynamics

The inertia of conventional machine concepts limits not just the positioning speed. Scanner welding also scores points in the area of dynamics during welding. Small geometries and flexible forms can be implemented easily, for example, when connecting the front plate to the pipes of an exhaust heat exchanger or when insert-welding of bolts. A major advantage is also the optimization of the weld seam geometry. As opposed to resistance spot welding, this method is not limited to the lens shape. Therefore the seam geometry can be adapted to the individual load of a joint.

“It isn’t enough to do the right thing. You have to be able to do it faster than everyone else.”

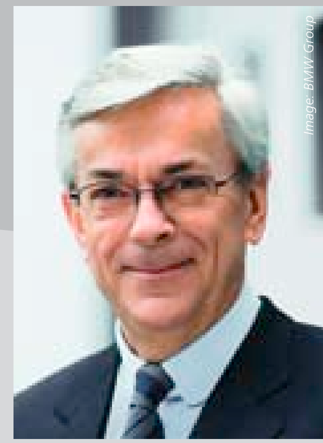


Image: BMW Group

Prof. Dr.-Ing. Dr. h.c. mult.
Joachim Milberg,
President of acatech

# Magic Circle

Innovation requires energy. And Joachim Milberg intends to harness it with feedback from both finance and research.

Being innovative means letting go at the peak of success and starting something new—without any guarantee of success. But that is often seen as a threat, not an opportunity, to set out for new shores with a creative innovation. This requires a fundamental change in mentality. What we need is a society that wants to grow and is capable of finding a new balance between sociological, cultural, economic and technological opportunities and risks. This society must be open to the future and prepared to take risks. In short, what we need is a society that is nimble, adaptive and foresighted—like a successful company.

**The key to this:** innovative growth. By this I mean the type of qualitative progress in which something original is created. If you want sustainable growth, you must first answer the question of how the capacity for innovation can be improved. To answer this question I would like to situate the innovation process within a circuit that is controlled by two poles affecting one another:

On one side of the circuit are the companies and the market that ultimately decide what innovations are. I will call that the implementation side. Companies that create innovation do not simply have to be inventive. It is also not enough to do the right thing—you have to do it faster than everyone else. For precisely this reason, innovative companies need new key abilities to be able to act successfully in various, even unforeseen “accidental” scenarios: namely the ability to act quickly, react quickly and adapt quickly to new conditions. This kind of company thinks and acts nimbly, adaptively and with foresight.

**Of central importance in bringing forth innovations** is the other side of the circuit. I call this the enabler side because that’s where inventions and new ideas are developed out of which successful innovations can come to market. It is on the enabler side that creativity, which is indispensable to innovation, is supported. The protagonists in particular are the universities and the science community, which through teaching and research generate new knowledge, new carriers of knowledge and new knowledge workers as well as research departments at companies.

While money must be employed on the enabler side to generate new knowledge, the market side uses this new knowledge to obtain money. These profits on the market side are then the very basis for any kind of investment activity on the knowledge side. Out of the immaterial knowledge comes the material, which is to say money, and vice versa. This means that the more profit that is generated on the market side, the more investment potential will exist for the knowledge side. In the ideal form of this circuit, a growth in knowledge means a growth in profit and vice versa. This positive feedback has to be our goal.

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*From Montevideo, Gerardo Rozenblum has his eye on markets from South America to India.*

# "It's good that we are so far away from Europe."

Cinter in Montevideo is the only tube manufacturer in South America working with lasers. We asked Managing Director Gerardo Rozenblum and Plant Manager Julio Bruno on the Tube fair in Düsseldorf how that affects what they do.

### Mr. Rozenblum, Mr. Bruno: What is it about the trade show Tube that interests the representatives of an Uruguayan manufacturer of high-grade steel tubes?

**Julio Bruno:** Different things. Our main business at Cinter involves high-grade steel tubes for vehicle exhaust systems. Our customers want additional processing steps to be integrated into the production process — processing tube ends and/or tube bends for example. We're also thinking of producing tubes not just exclusively on rolling form systems but also on short tube systems and welding them with lasers. We're learning about that here at the trade show among other places. One of our projects involves a high-grade steel tube in the exhaust system that is later spin-formed or hydro-formed, thereby exposing it to extreme elongation and high forming forces.

### So, high-tech. And who are the customers for that?

**Gerardo Rozenblum:** We supply customers predominantly in the automotive industry, mostly Tier One suppliers; also in Europe, in Holland and Belgium. Our main markets, however, are South America, Mexico, United States and India. In South America we have a leading position in most countries for high-grade steel tubes used in exhaust systems. Each month we produce about 1,500 tons of high quality tubes of stainless steel and aluminum-coated carbon steel, out of our production about 30 percent are tubes for very special applications. These are niches of market.

### That sounds like a strategy for the high wage zone of Europe, not for South America.

**Rozenblum:** It's similar around the world. Everyone today wants to produce large quantities, but the large companies can do that better. What's left over are niches, which in term of annual volumes are too small for them but not for us. We are a small, family-owned company with 170 employees that in recent years has grown up quickly. Today we are focusing a lot in finding and serving these niches because we see an opportunity for greater profit. Profit is a question of quality, not quantity.

**Bruno:** Moreover, that strengthens customer loyalty. Customers need us because we've developed their tubes and have mastered their processes.

### What role does the laser play in all this?

**Bruno:** An important one. We've been using lasers for welding tubes purposes since 1998. We were the first ones in South America and are still the only ones for this application. The next tube welding laser is in Mexico. We are using five, in the near future six lasers — two 6 kilowatt systems and four 8 kilowatt lasers — all from TRUMPF. The main reason is quality: High-frequency welding may be faster than laser welding, but setting up an HF welding system is very complicated, takes a long time, is meant for large tube productions and the set up is most costly because of unavoidable scrap. We are more efficient and flexible with laser mills because thus we have many mills with many sizes producing at one time and we do not have to change tools very often like in HF. For all these reasons we prefer to have several laser mills than one HF mill.

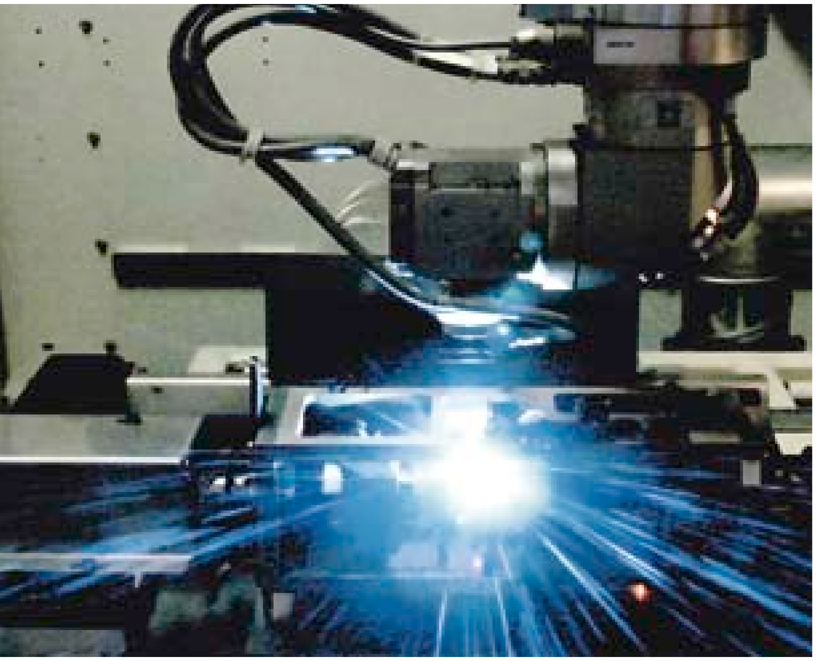
*Julio Bruno prefers to built tools himself so that his company can react faster.*

**Rozenblum:** At the end, it's probably an advantage for us to be so far away from Europe. We develop our own processes and also build our own tools so that we can react quicker and more flexible to customer demands.

### Are you technically comparable to European companies?

**Bruno:** I think the equipment and the level of technology are the same. We are certified according to quality assurance standard ISO TS 16949 for the automotive industry and we go through related audits. Our auditor comes from Austria. He knows his way around the industry and he conducts audits on European, Asian and American tube manufacturers as well. ■

**Contact:** Gerardo Rozenblum, grozenblum@cinter.com.uy



Partner found: Amtek welds guide housings for ThyssenKrupp Presta in Singapore.

Project manager Johnson Chan of Amtek has an eye on the benchmark: a split measure of 0.1 millimeters was a central demand.

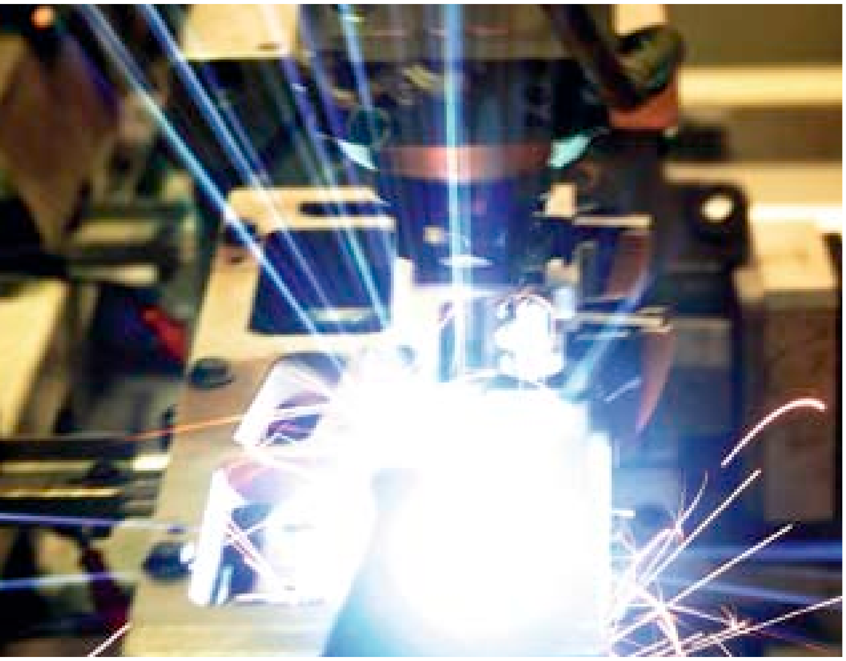
# Global Play

## Two engineers of ThyssenKrupp Presta and TRUMPF meet in the heart of Europe. The beginning of a globally aligned project.

Two companies, one goal: ThyssenKrupp Presta, a prominent manufacturer of steering systems for the automotive industry, was looking for new suppliers for South America and Asia. TRUMPF, leading manufacturer of lasers and laser systems for material processing, was living up to its global responsibility and accompanying its customer on the way to international markets. What was still missing was the third member in the group: the partner who would supply the required construction units locally in the emerging markets.

The result of a first comprehensive assessment in Brazil: no suitable partner could be found. Second attempt, in Shanghai: after examining and evaluating several prospective partners, Amtek Engineering Ltd., located in Singapore, was chosen as manufacturing partner. It's also no coincidence that Amtek, a public company, put so much effort into it, because although up till now they've been best known as a supplier for the electronics industry, including such giants as Hewlett Packard and Philips, they wanted to strengthen their position in the automotive industry. So ThyssenKrupp Presta's request came at just the right time. After all, Amtek Metall-Forming's new plant in Shanghai was intended specifically for the automotive industry — and was ready for innovative solutions.

**Investment provided** Unlike the other hopefuls, Amtek barely flinched at the idea of the new project. ThyssenKrupp Presta was expecting no less than the investment in a 3D laser welding system and the mastery of this complex technology. Johnson Chan, project leader at Amtek, looking back, summed it up saying, "We wanted to quickly implement what was still lacking."



Speed attained: a maximum cycle time of 20 seconds for the welding process.

Johnson Chan (right) and his team know everything about laser technology.

Amtek has of course worked with lasers for a long time before now, but only in the areas of cutting and marking. Chan says, “Laser welding was almost unheard of in Southeast Asia in 2004, when the project began. We were in uncharted territory.” Amtek had competent fellow travelers to ensure safety in the unknown terrain. In addition to TRUMPF as the system partner, the Singapore Institute of Manufacturing Technology (SIMTech) came in. Its task: set the pace for Amtek’s internal qualification, process counseling and active cooperation with the specification of workflow and system configuration.“SIMTech,“ says project leader Johnson Chan, “used its know-how to lead us safely past the critical points in the laser welding process.” Together with its project partners, Amtek qualified its employees. Chan: “For laser welding you need not only well trained specialists on the machine but also a lot of know-how with programming and parameter definition.” Today the Amtek team is fit in all respects and masters welding parameters, beam focusing and the metallurgical behavior of many different materials.

**A global game** Parallel to SIMTech’s work, TRUMPF application engineers developed the welding process and defined the machine layout for the first sample construction unit: the guide housing of a deflection column that can be adjusted horizontally and vertically. An assembly that is compiled from four components and whose gap of 1/10 millimeter requires the highest precision and process reliability. This is a challenge. After all, the plant was supposed to be designed based on plans by ThyssenKrupp Presta in such a way that an annual production of 900,000 parts is possible.

A maximum cycle time for the welding process of 20 seconds — that was the benchmark for the application engineers. But what use is optimizing production time if unproductive secondary time drastically reduces yield? After all, according to the field engineers’ first analysis, equipping the machine with the four output components takes five whole minutes. Innovative solutions were required. A cassette was developed as a workpiece holder that could be equipped completely decentralized. And the machine layout was defined in such a way that the five-axis machine LASERCELL 1005 was equipped with two workstations. The remaining is logistics: Conveyor belts transport the loaded tool carriers from the assembling place to the machine. All the worker has to do is switch the cartridges so the manufacturing process runs nonstop. 24 hours a day.

This pilot project has long worked in practice. Besides the guide housing for the steering column, other products are optimized for laser welding. Thanks to the flexibility of laser light as a tool. ■

**Contact:** Johnson Chan, johnsonchan@amtek.com

## SAMPLE CASE FOR COLLABORATIVE BUSINESS

Collaborative business is the keyword for cooperation between manufacturers in world-wide business. The term, coined by the computer manufacturer HP, emphasizes the importance of the protagonists’ global play: Everyone involved focuses on their strengths, thinks across company lines and connects their know-how with their own strength. Amtek as a qualified supplier, SIMTech, the neutral advisor, TRUMPF as a system and process supplier, and ThyssenKrupp Presta as end customer and ordering party.

*Sometimes everything depends on a tiny thing. That's just fine if every part—no matter how small or large—can be identified without a shadow of a doubt using data matrix.*

# Tell me where you come from

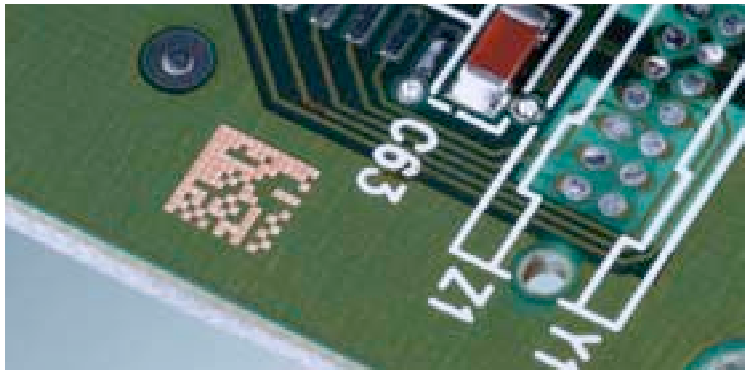
Stricter product liability laws and shrinking margins are forcing more transparency in production processes. As a result, the call for 100 percent traceability for all components is growing louder.

Worldwide, 271 people have died as a result of defective tires and accidents involving overturned Ford Explorers. Consequently, one of the largest recalls in economic history almost led to the end of the Firestone tire brand. Though recalls are not the exclusive domain of the automotive industry, spectacular cases have been accumulating there in recent years. Last year Toyota recalled about 880,000 vehicles and, according to the Federal Office for Motor Traffic, more than 1.4 million vehicles were affected by a total of 137 recalls in Germany in 2004 — more than ever before. Experts say that the costs of such actions are somewhere in the tens or even hundreds of millions of Euros. But what is often even more costly to manufacturers: damage to their image in the eyes of consumers.

The main reason for the abundance of recalls is that lawmakers worldwide are making product liability laws stricter (see box on page 22). Times are getting tougher for manufacturers of safety-related components such as the aviation, automotive and electronics industries. Therefore it's high time for every company participating in the production process to act. A Herculean task — especially given prevailing cost pressures, increasing complexity of end products, greatly decreasing vertical integration and shorter development times.

**Traceability: Back to the origin** But how can faulty components — and the associated damage to image as well as the high cost of recalls — be limited or even prevented? The formula for success is the total traceability of all components.

Traceability is essentially on par with maximum transparency for all of a product's components. Traceability systems generate product-specific datasets and during the production and assembly process store all production-related information for components used: material composition, supplier, batch number, measurement values and production time. Marking tools in turn ensure that every part is given a distinct identity similar to a fingerprint. But a targeted traceability "back to the roots" is only guaranteed if the coding


*The quadrature of information: Computer-readable data matrix encodes much more data on much less space than the barcode. For example, a laser can put a 24-digit code on four square millimeters.*

is readable with a high degree of security. This is the only way that proactive action is possible if faulty parts have been installed. Manufacturers can then, for the most part, prevent comprehensive recalls using what is known as unique batch traceability. This saves costs and preserves the company's image.

**Dense information: data matrix code** The bar code has been used in the past to mark components. When setting up the traceability process, manufacturers quickly come up against the limits of this coding. Information density, for example, is one limitation. This is a growing phenomenon and not only in the automotive industry. Shortened product life cycles, growing model variety as well as design and production-specific changes along with the formation of different versions are characteristics of nearly all products. At the same time, development, particularly for electronic components, is moving steadily in the direction of miniaturization, so that there is simply no more room on many parts to put a barcode with the usual procedures like label printing, inkjet marking or needle imprinting.

But this does not mean that a reliable traceability system will fail in the current environment due to such challenges and barriers. Putting a lot of information in a tiny area with modern laser technology is anything but witchcraft. For example, lasers enable a 24-digit code to be placed on a two-by-two millimeters area. Even on the most densely filled circuit board there is sufficient room. Whether the components are made of glass, plastics, metal, with raw, oily or dirty surfaces, there are hardly any obstacles for the energy-rich light. In particular, the data matrix code (DMC) markings can be read with an unsurpassable degree of security due to error checking and correction operations. Regardless of the angle under which they must be decoded, even when 20 percent of the marking is obliterated, the necessary traceability information is not lost.

**Dream team for secure traceability** The laser as a marking tool and the data matrix code as an information carrier together form an ideal symbiosis. The advantage for manufacturers: In the future they will no longer have to install anonymous assemblies and can use the traceability information to track the path of all individual parts right back to their points of origin. Responsibility as it relates to product liability is then clearly outlined. And costly, image-damaging recalls of entire series will be a thing of the past. ■

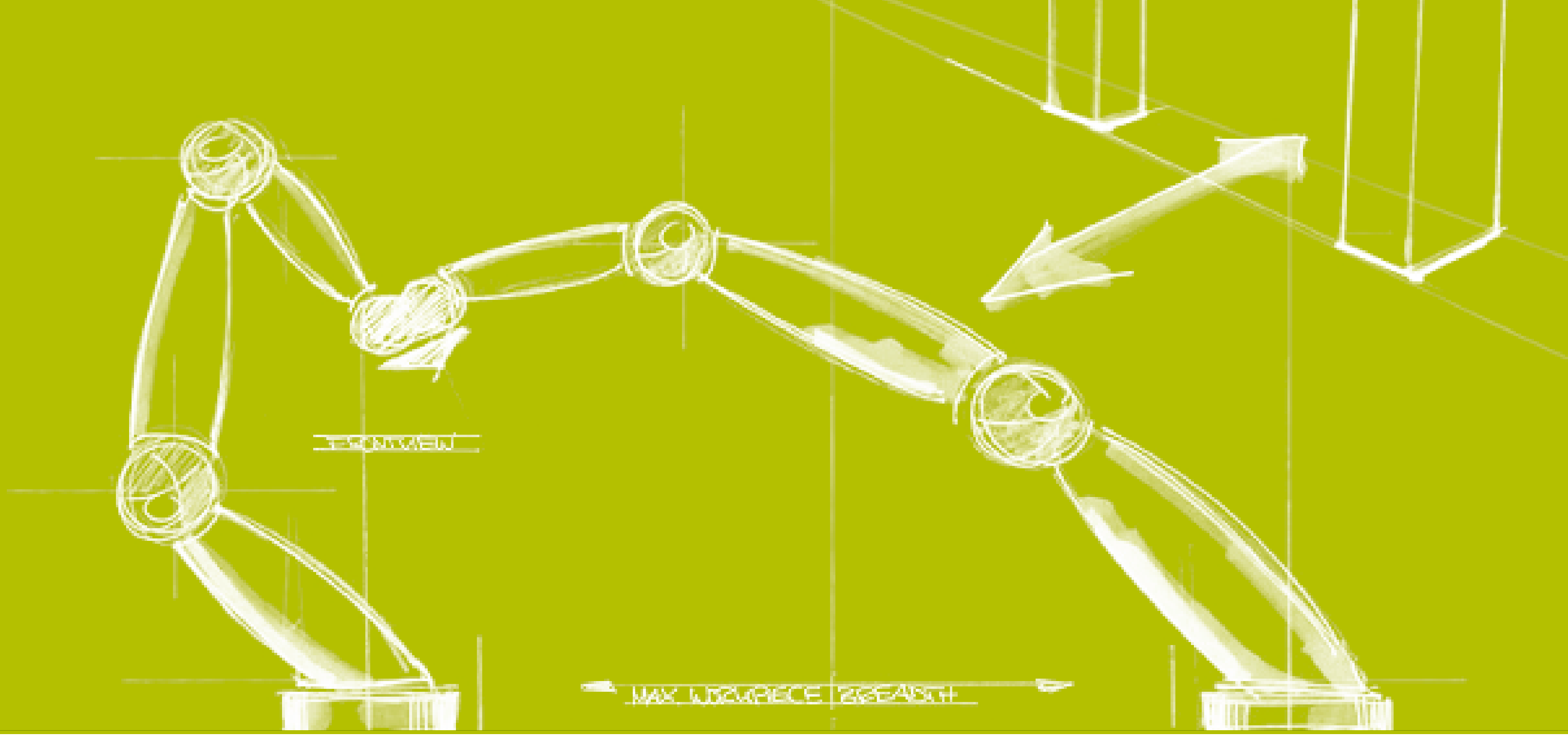
**Information:** www.lasermarking.trumpf.com

## LEGAL BACKGROUND

Lawmakers are increasing the pressure on product manufacturers. As of January 1, 1990, liability must be assigned for damages caused by faulty products regardless of guilt. On August 1, 2002, a law amending punitive damage provisions took effect that added compensation claims for pain and suffering to product liability. Stricter provisions are now being considered in Europe. For example, since January 1, 2005, EU Ordinance No. 178/2002 has been in effect, stipulating, among other things, the traceability of products from the food industry. With the US Tread Act in 2000, the United States established a global early warning system in the automotive sector for consumer protection. Within five days following a recall, manufacturers must notify the responsible authorities — NHTSA (National Highway Traffic Security Agency) — if the vehicles or components affected are the same as those that are marketed in the USA. If companies violate the Tread Act, fines of up to US-dollar 30 million can be imposed.

Why do laser welding systems move the workpiece through the portal?

Can't the portal also move over the workpiece?



# Moving beyond Thinking in X and Y

**Project Future. Here is what happens when 13 up-and-coming designers think about laser welding systems: innovative technology.**

To think outside the box, George Teodorescu doesn't have to go very far. His trick: He simply sets up shop on the edge of it. From this perspective, the Professor for Master of Design and Integral Studies at the Akademie der Bildenden Künste Stuttgart, Germany, develops approaches and concepts together with his students. "We've thought about the special qualities of an industrial laser system. Workpieces are not processed with mechanical forces but rather with pure energy. So what interested us most was the nature of this technology, which we then wanted to translate into new product architectures," explains Professor Teodorescu. In so doing, he is proclaiming a method that combines two contrary modes of thought — the logical/pragmatic with the speculative/visionary. In other words, engineering meets art. George Teodorescu himself then speaks about the "conceptual innovation." →

*Six innovative ideas and their creators …* →

With this understanding about innovation, it was easy to talk to Andreas Kettner, Director of Development for laser systems at the TRUMPF Laser- und Systemtechnik GmbH, into a joint project. “We were particularly interested in how you could approach the development of laser machines differently from the way our engineers do it today, and how you could create something completely new,” says Kettner explaining his motivation for this unusual project.

> “Laser machines can be developed differently from the way our engineers do it today. We wanted to know how.”

**Topic request: Spatial concept** “We are faced with a series of challenges in the design of our machines. They range from reducing the relatively high number of parts and variants, to improving the performance parameters, to optimizing the human-to-machine interface and ergonomic properties,” reports Kettner, adding “We are particularly interested in a revision of the spatial concept of our systems.” The students’ drafts demonstrated that there was room to work with.

**Crash course in laser technology** A series of specific parameters was first defined for the project. Top priority went to safety aspects in handling laser light. Likewise it was important that the necessary peripherals such as power supply or cooling be dimensioned to the same scale as available today. Numerous application scenarios were discussed, including the analysis of large objects taken from the field of truck construction. For example, this is how the migrating system concept ProG from Dietmar Fissl arose. It’s no longer necessary for the workpiece to come to the machine; rather the machine can go to the workpiece.

The students Chen Zhihong, Lee Byoungsam and Werner Martin wanted to break with the traditional forms and make life easier for the user. The result was T-Circle, a round machine with a supported laser arm similar to a magnetic levitation train. The machine is accessible from all sides, can be loaded with little effort, is much quieter than the traditional version, and is variable in its size. “With such desktop versions, the laser is also interesting for processing smaller parts,” explains Chen Zhihong.

**Moving beyond thinking in X and Y** A major factor for conceptual innovations that was also taken up by Chen Zhihong is represented by new geometrical approaches. While navigation is performed in mechanical engineering using the classic XY motion derived from mechanical processing, the students used other systems such as polar coordinates. In combination with telescoping sleeves, the result was not only more compact machines, but also more flexible processing possibilities and improved accessibility to the processing area (Trova, Inkontrol, T-Circle). One innovation common to all drafts calls for more flexibility and more efficiency: Workpieces will cease to be positioned on the machine table as they are today, instead being pre-tooled on an external workpiece support module. The potential to calibrate workpieces using an integrated scanner (T 1000, T-Circle) in the area of machine tool construction has largely been unexplored, according to development chief Kettner. “The advantage lies in the simple and cost-effective — because it’s not precisely aligned — workpiece support. In conjunction with an external machine table, this approach could even be expandable to automation,” says Kettner enthusiastically.

Less space requirements, faster initial startups and shorter warmup times were achieved in all drafts particularly by integrating the additional units such as power supply and cooling. And in most cases the machine operator is no longer hemmed in. To operate the machines the user has complete interaction possibilities using movable control panels wherever he is.

**Glimpse into the future** Andreas Kettner is definitely enthusiastic about the models: “We didn’t expect such a variety of ideas and innovations. Of course not every approach is exactly ready to be realized, but that is what is so charming to us about the project.” Professor Teodorescu also sees the limiting factor for economic viability: “Development planning for a company only permits a limited flexibility in implementing innovative concepts. That’s why our ideas were based on envisioning the next but one generation of machines.” Nevertheless, one thing is crucial for both of them: Implementing these ideas right from the very start was about detaching from traditional machine tool building. And at the same time, create a new type of machine that was to unfold the character of laser technology anew. ■

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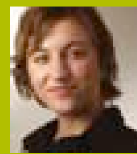
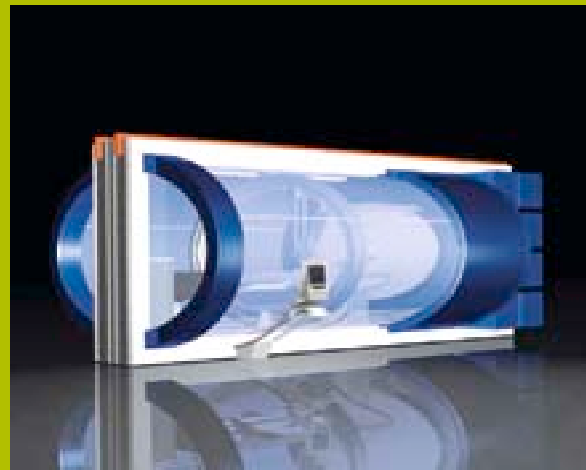
**Pro G** — *Working flexibly on large parts as well with multi-articulation kinematics. The tool moves toward the work-piece. The processing optics are calibrated with local GPS.*

Dietmar Fissl

Minsun Kang

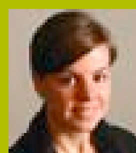


Helen Wegener

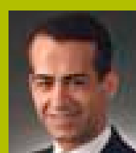


**Trova** — *More compact machine through telescoping sleeves. The main axis motion is vertically revolving. Top and bottom are processed without clamping.*

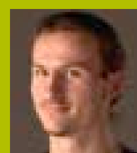
**T 1000** — *An approach with potential for automation. Free positioning on an external workpiece support; subsequent calibration using the integrated scanner.*



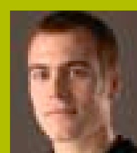
Linn Rodesjö



Okan Yapici

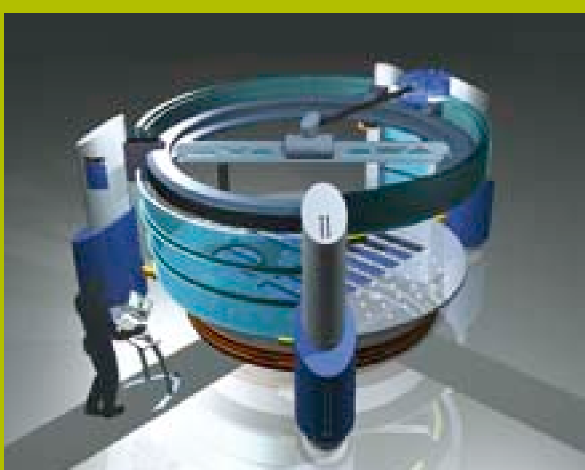


Bálint Pallag



Mario Pöss

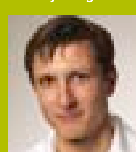
**Pro Q** — *This model is based on a multi-articulation kinematics connected on both sides. The system is minimized; the laser beam is shielded locally.*



**T-Circle** — *Good accessibility, elevated dynamics, and more precision through balanced masses with a horizontal arched main axis motion.*

Chen Zhihong

Lee Byoungsam



Werner Martin

Mathias Huntscha

Harriet Kasper

Hansun Kim

**Inkontrol** — *Driving all-around the workpiece using a vertical arched main axis motion. The laser beam can follow by using movable mirrors.*

# Lord of the Disks

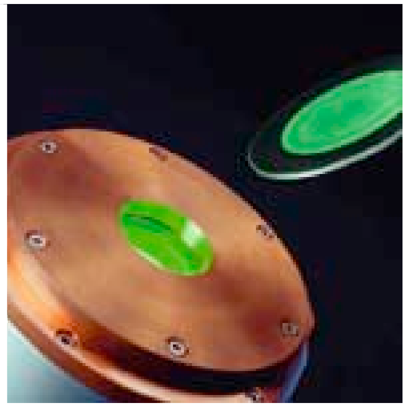
He simply doesn't fit the stereotype of the bony scientist. Cloistered away in the ivory tower? Not Adolf Giesen. If you ask the inventor of the disk laser what characterizes his everyday life, then the answer comes quickly: discussions — mostly with colleagues in a team environment — but also with doctoral candidates, students and the industrial world. "I'm not the typical theoretician, but rather an experimental physicist with a heavily theoretical background and an enormous practical interest," says Giesen. "But without intense theoretical activity, a high-powered laser could never be realized."

In 1992 Giesen showed how that works. Following the basic theory of the MIT scientist T.Y. Fan, whom he considers a great visionary, he laid the foundation for the disk laser with his colleagues Klaus Wittig, Uwe Brauch and Andreas Voß. The idea of how it could work came to Giesen on the return flight from Fan's lecture in Los Angeles. Three months later the key elements were in place. This was after many discussions within the team — always on Fridays starting at 2 p.m. (with homework for the next meeting) and always open-ended, of course. Time was not an issue for the major players. Only the result mattered. Or as Giesen says: "Whenever someone said that something wouldn't work, I was only tempted further. And usually it would work." By now he has proved that in his career often enough, but it wasn't always clear that he would become a physicist …

There's no research prize that can make him more famous.
He's already well-known as the inventor of the disk laser..
A portrait of Dr. Adolf Giesen. World-famous scientist, person of stature.

**Pianist or physicist — that once was the question** Flashback: December 19, 1946. Adolf Giesen sees the light of day for the first time. He grows up in the tranquil village of Mechernich in the Eifel region of Germany, attending secondary school at Euskirchen. Even then during voluntary afternoon experiment classes with the physics teacher, his passion for physics experiments grew along with the desire to push the limits. His second passion is music. He played the piano, performing with his brothers in the group "The Swinging Brothers," and worked at the local concrete plant to earn money for instruments. "For a long time it wasn't clear whether I would become a musician or physicist. Then circumstances made the decision for me," explains Giesen. More precisely, two years in the Army and an obstinate company commander. A piano in the barracks? Impossible! That was the turning point for Giesen: "After such a long time without a piano, you forget too much.  You can't catch up." In fact Giesen then wanted to study electrical engineering. But a professional adviser convinced him to return to physics. Giesen's passion, which had not died out from his school days, was rekindled, carrying him through his university work to a doctorate in 1982 — with a secondary focus on astronomy — and the German Aerospace Center (DLR), and finally to the IFWS, the Institut für Strahlwerkzeuge at the Universität Stuttgart. →

*"That's impossible" is something that Dr. Adolf Giesen doesn't like the sound of. "More often than not, it works out in the end, if only you change perspectives", he says.*



*He could have been a professor at the NASA Space Center in Alabama. But Dr. Adolf Giesen did not want that. He prefers the scientific freedom at the IFSW that allows him to advance the disk laser.*

**THE DISK LASER**

A disk laser is a solid-state laser. In this case the active medium (the laser crystal) takes the form of a disk. Its advantage is improved cooling of the laser crystal: The disk is bonded to a heat sink with the reflective surface. Through short paths of heat deflection in only one direction, only little thermal tension arise. Typical crystal material is strongly dopted Ytterbium YAG. The disk laser achieves almost any level of laser power with maximum constant beam quality and maximum efficiency because the power increases in direct proportion to the disk area.

**THE IFSW**

The Institut für Strahlwerkzeuge (IFSW) at the Universität Stuttgart, founded in 1986 by Professor Dr. Helmut Hügel, is one of the world's leading laser institutes. Its strength is based on a holistic approach that blends both the development and application of laser beam sources.

*www.ifsw.uni-stuttgart.de*

In December 2006, Giesen will turn 60, but you would guess that he was only about 50. A grin forms: "There's nothing astonishing about it. I do feel young as well." Optimism and enthusiasm, his teamwork and also his patchwork family keep him young: "Everyone is always together at Christmas." Six children gather around him, three of them his own daughters, by now all grown up, as well as his second wife, who is a therapist. You can well imagine an evening with the Giesen family: Intense discussions, hearty laughter and culinary enjoyments. Nothing boring, rather a lust for life *en famille*.

**Formula for success: Freedom** In his professional life, Giesen values his personal freedom. And he may have earned his doctorate, qualified as a professor, and garnered many awards for his stroke of genius the "disk laser." He has even won first prize of the Berthold Leibinger Innovationspreis. But he has never accepted a professorship — despite attractive offers. As for example in 2000, when a call came in from Huntsville, Alabama, a US town surrounded by cotton fields "in the middle of nowhere." Or as Giesen puts it: "Not my favorite place to be." Although the call to Huntsville came from the NASA Space Center located there, Giesen turned the offer down. Today he is glad. For good reason. At the IFSW, on the Pfaffenwaldring campus, Dr. Adolf Giesen found the scientific freedom that he so values. And that's why he causes a stir there — as the father of the disk laser.

Space to design, to talk, to exchange ideas — freedom. For Adolf Giesen that's a central element in his life. The way he starts the day on a morning walk through the forest, clearing his mind from everyday concerns, he creates a calm atmosphere in his teams. Loosening constraints, overcoming conceptual blocks, clearing aside barriers: Dr. Giesen is a persuasive man with an unshakable belief in the possible.
Dogma isn't his thing. "In the same way that an individual can't presume to divide up the world into good and evil, I disapprove of unreflective discussions and disputes over direction." For example, he thinks that the recently growing dispute over the principles of fiber and disk lasers is too emotionally charged. "I know my disks and know exactly what they can do," he says calmly.

Calmly but with a lot of passion and commitment, Giesen also observes his teaching obligation. For his two hours of lectures a weak, Giesen hardly needs to prepare. After all, he says, "My head is always full anyway." He comes up with his lessons easily and spontaneously. And he fascinates his audience. He enjoys the praise by one student who attended his lectures during the winter semester. "Why do you think I'm here?" he says. "Not just because of the subject!"

Giesen's subject is and remains the disk laser. According to the inventor: "It's not done with one great success alone." Unrecognized potential spurs him on. Right now during the discussion he is preparing a new record experiment on performance. Giesen believes that the disk laser's actual power limit is beyond a megawatt. The transfer into practical use holds the same excitement for him. "My goal is to show the broad range of application that is possible. And that's work for many more years," he says. ■

## "Given the situation, the laser was never invented?"

# 5 QUESTIONS FOR DR. WILLEM HOVING

## *"I would have found another source of photons to play with."*

4

*Which laser application seemed impossible ten years ago?*

High-throughput welding for example in car manufacturing; large-area laser material processing such as laser structuring and silicon recrystallization. Even welding of plastics: Some of my colleagues started a bet that it's impossible. Obviously they lost.

3

*Your wish, what lasers should also be able to do?*

Making very compact and cost-effective lasers: using big lasers to make small lasers!

2

*What change in laser technology is for you the most important one?*

In the previous century there was much focus on the development of the laser technology itself. In this 21st century we see the laser much more like a tool, which has proven itself in many industrial applications, and which competes with all other technologies.

1

*Do you have any laser technology role models or "idols"?*

No role models, but I admire the scientific pioneers for example from Stanford University, but also the industrial pioneers such as Gerard Notenboom and Paul Seiler who brought the first solid-state lasers into industrial production.

*Dr. Willem Hoving has been fascinated by the Laser since his physics studies at the University of Groningen, in the Netherlands. He deeply dived into the laser world in 1992 when he joined the laser group of Gerard Notenboom at the Philips Center for Industrial Technology, working with high-power lasers for industrial micro-joining and micro-assembly. Today he is Principal Scientist at Philips Applied Technologies in Eindhoven, Netherlands. His current professional interests are compact solid-state lasers for applications in new consumer products.*

**More questions to Dr. Willem Hoving:**
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*That's what it might look like, once Dr. Olivier Acher's "laser printer" hits the market.*

# Ink That's Cutting Edge

Who would bother using scissors when there are lasers? Olivier Acher adds cutting of paper to an inkjet printer.

The goal scorer in soccer's World Cup — photographed in the stadium, comes alive again as a cut-out action figure at home. At least if you ask Olivier Acher from Monts, France. He entered the idea for an ink-jet printer that prints and cuts in the Berthold Leibinger Innovationspreis. The principle behind his innovation: The printer outlines the cutting lines with an ink that absorbs infrared light. This ink reacts with the laser light — white paper doesn't. An inexpensive laser diode of only a few watts does the rest: It burns the ink and paper away, making precise cuts. Some of the possibilities that Acher sees for application include registers, home-made labels, greeting cards, or individually tailored photos. And the cutting-edge ink-jet printer can do even more. By adapting the speed and power of the laser, folding lines can also be easily "lasered" into the paper — appealing to anyone with an interest in creating inexpensive brochures or flyers. ■

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# The Truth

## David Belforte on facts and trends within the global laser market.

Although lasers had been invented and commercialized earlier, the first industrial markets developed in 1970 with laser sales revenues of US-dollar 2 million. The laser industry considers this as the beginning of its business. Since then, this sector has grown at a compound annual growth rate of 20.17 percent and, most significantly, during this period this global market experienced only one period, 1991–1992, of zero growth. The years of substantive annual growth started in the late 1980s as sheet metal cutting evolved into a major revenue-producing application, and the first penetration into the automotive body welding sector began in the mid-1990s. Today this vibrant technology is used, around the world, in a variety of industries. Statistically, the world market for industrial lasers in 2005 was 35,000 units valued at US-dollar 1.3 billion, integrated into systems with sales revenues of US-dollar 4.3 billion.

The rise of Southeast Asia as a significant market has changed the character of the industrial laser market and has added a number of new product suppliers that compete domestically and eventually will export to world markets. Last year 16 percent of industrial laser system installations occurred in Southeast Asia and 18 percent were installed in Japan. Europe at 33 percent and North America at 25 percent and the remainder at 6 percent compose the rest of the world's unit installations. The picture changes dramatically when looking at 2005 system revenues with Asia slipping to third place at 22 percent due to the low dollar value of systems built and sold in China. Europe at 38 percent and North America at 32 percent are thus more important from a revenue standpoint.

A review of current applications being served by industrial lasers suggests that few approaching the market saturation mode and those close to maturity have sufficient replacement business to continue substantial sales for the near term. More importantly, it is not apparent that many serious threats exist as substitution or replacement of lasers in manufacturing operations. Lasers are well established, accepted, and proven as profitable, reliable, easy-to-operate, low maintenance equipment. By these measures the industrial laser market looks solid for the next few years. ■

Read David Belforte's detailed analysis including applications and laser types in the detachable Laser Factbook.

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*David Belforte, American publisher and editor-in-chief of Industrial Laser Solutions, is one of the most renowned insiders of the laser field.*

# Where's the laser?

*AT OSRAM, IT'S IN THE SAFETY* The safety of the car driver: With 200 Watt pulsed lasers from TRUMPF, the light manufacturer welds its car headlights precisely to the socket. If the position of the lamp is off by only 1/10 of a millimeter, then the car driver's illuminated field of vision changes — perhaps by a crucial meter. Laser welding gives every lamp exactly the same beam qualities and lamps can be used immediately upon installation. OSRAM designed its vehicle lamps so that the laser's advantages can be maximized during production — and in the meantime they apply several hundred million welding spots per year.