DR.-ING. E.H. PETER LEIBINGER

Leibinger: "Photonics is disruptive"

An essay from Peter Leibinger, Chief Technology Officer (CTO) and Vice-Chairman of the Managing Board of the TRUMPF Group, on the meaning of digital photonics.

Tech pioneer Phillipe Kahn took a photo after the birth of his daughter using a cell phone prototype he built. He then shared it with 2.000 friends and his family. This was the first cell phone photo ever shot and sent. It is one of the 100 photographs that changed the world according to Life magazine. Today, 200 million photos are uploaded every week on Facebook alone. Nearly 2 billion smart phones with an integrated camera will be sold in 2017. Digital photonics is enabling the digital world and really should be called "disruptive photonics".

Photonics is everywhere in our everyday life but it is mostly invisible. The Internet is such an example: The amount of data on the internet has grown 14 million times in the past 12 years. Only through harnessing light can we manage this tremendous ongoing growth. The lifelines of our modern society and economy are made of light. Millions of kilometers of optical fibre connect the world.

Light at work

Another example is manufacturing: here the laser today is the most versatile tool. It is a tool with unprecedented flexibility and unequalled precision. The spectrum of laser applications ranges from ships to chips. Only the principles of laser lithography enable the Semiconductor Industry to create structures the size of a virus on the chips. Leading edge today is 14 nm, the Rhino virus that causes the common cold is twice as large. EUV lithography will enable chips with feature sizes of 5 nm in the near future. What it means for us personally is faster, cheaper and more energy efficient smart phones, computers and other devices.

Lighting our world

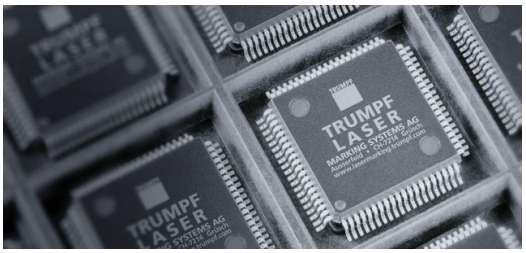
And there would be no light without photonics: Lighting as a whole accounts for around 19% of global electricity consumption. The need for energy-efficient lighting was solved by photonics with white light LEDs. Their efficiency is unmatched. When we have completely switched to LED lighting around the world, electricity consumption for lighting will have been reduced by more than 50% which equals savings of almost 750 million tons of CO2 each year.

Watching the elements of life

Completely novel microscopes are enabled by Photonics as well, making it possible to observe a living biological cell. This capability is the fundamental for us to attack many diseases, including cancer. Photonics is also the most crucial tool in science. Lasers in different sizes enable spectroscopy or microscopy or space telescopes.

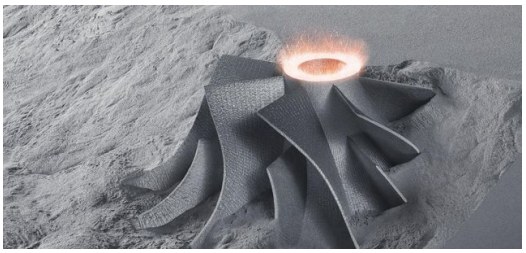
Digital Light – it's about intelligence

And without photonics as an enabling technology, there would be no digitalization. Both go hand in hand. One example is Connected Light. I will enable many new applications. Street lights will be equipped with sensors and cameras and will be connected. They will be able to monitor air quality, enable location services, traffic control apps will derive from this feature. Communication capabilities will enable applications such as the availability of parking spaces and guidance of autonomous vehicles to these spaces. The installed base of street lights in 2015 was around 350 million. The infrastructure they represent is a grid we can harness! Digital Light is not about illumination, it's about intelligence.

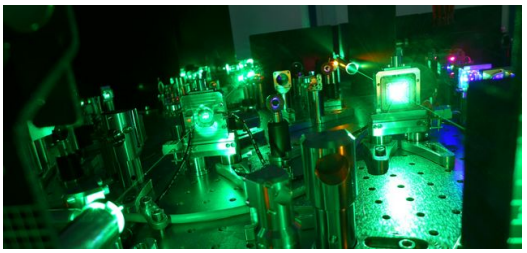


EUV lithography will enable chips with feature sizes of 5 nm in the near future.
Picture: TRUMPF

In manufacturing Industry 4.0 will lead to an unprecedented push for flexibility. Optical sensors and measurement devices will provide the data needed.
Picture: TRUMPF



3D printing will become an important new manufacturing method leading to massive cost saving.
Picture: TRUMPF



Through the development of ultra fast lasers with pulse widths in the femto- and attosecond range extreme powers are possible.
Picture: TRUMPF

The eyes of Industry 4.0

The other game changer that everyone is talking about these days is Industry 4.0. In manufacturing this will lead to an unprecedented push for flexibility. The laser as a flexible and versatile tool plays a key role here. Optical sensors and measurement devices will provide the data needed. We can say that photonics creates the eyes and senses of Industry 4.0. However, traditional laser, sensor and machine manufacturers will have to transform themselves to becoming a software centric hardware manufacturer. Digital manufacturing will drive convergence of hard- and software.

Flexible tools for customers needs

Flexible Industry 4.0 tools will need to be able to interact with their environment, as well as new types of machine interfaces. Robots will become cobots. These collaborative robots can move safely and freely in the factory through the use of vision based sensors and through intelligent algorithms. Novel camera systems are needed that are able to perceive their surroundings in a similar way as the human eye does. Depth of field, motion and surface structures must be recognized. Only this way a genuine human machine cooperation will be possible. 500.000 new cobots a year will be sold worldwide by 2025 according to Barclay Research.

3D printing, Additive Manufacturing, is another enabler of Industry 4.0. 3D printing is the only seamless connection from digital to material known in manufacturing today. It will become an important new manufacturing method. Reduction in complexity, improved specifications and many more factors lead to massive cost savings – and totally new possibilities and freedom when it comes to design.

Peter Leibinger

is Vice Chairman of the Managing Board of TRUMPF SE + Co. KG and Chief Technology Officer (CTO). He is responsible for research and development, sales and service, the development and expansion of new Business Units Born in 1967 in Stuttgart, Germany. Studied mechanical engineering at the RWTH University in Aachen, Germany. Shareholder in TRUMPF SE + Co. KG since 1994. Development Engineer at Ingersoll Milling Machine Company, Rockford, IL, USA from 1997 to 1999. From 1999 to 2003, Chairman and CEO, TRUMPF, Inc., Farmington, CT, USA. Managing Director of TRUMPF SE + Co. KG since 2000. Head of the Laser Technology Business Division since 2003, and Managing Director of TRUMPF Laser GmbH + Co. KG from 2003 to 2005. In November 2005, Peter Leibinger was appointed Vice Chairman of the Managing Board of TRUMPF SE + Co. KG. Leibinger also performs many honorary functions.

Light for mobility

Autonomous cars will change mobility completely. They are enabled by photonics. Without photonics sensors, digital cameras and displays, computer vision systems, both visible and infrared, taking millions of data points each second, autonomous cars could never become reality. Our industry is at a forefront of this development today and we expect this to be a 9 billion euro market for photonics by 2020.

Extreme Light: No Limits

Another highlight is extreme light. Through the development of ultra fast lasers with pulse widths in the femto- and attosecond range extreme powers are possible. Such lasers are used as production tools already today, even more powerful versions are being developed and built in the ELI "Extreme Light Infrastructure" project in Europe.

Extremely energetic pulses will enable completely new technologies. One such new technology is the substitution of

synchrotrons and the generation of synchrotron radiation for medical and other applications. Today a synchrotron costs upwards of a hundred million Euros and is few hundred meter in diameter. It is conceivable to build a table top version of this using ultra short pulse lasers to generate ion or proton beams, that are used for the treatment of cancer and new types of cancer diagnoses.

It will even be possible to use such energy in the transformation of nuclear waste to benign isotopes with very short half life times. The use of high energy lasers indeed seems to be without limits.

Enabler of digitalization

Photonics is a powerful and high-tech industry, creating leading edge technology for a worldwide 650 billion Euros market in 2020. But photonics is more than just a successful high-tech industry. It is the enabler of digitalization in many ways. This leads to huge opportunities and risks for our industry at the same time.

The opportunities are obvious. But, with the markets we serve, through the industries we enable, we will have to change ourselves.
Because we disrupt, we will be disrupted. If we do it well, photonics will be the glue and the enabler for the big topics in the digital society. The solutions will be to be the drivers of the change, not the victim.

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