PRESS RELEASE

AKL - International Laser Technology Congress 2024 in Aachen

"Huge, completely untapped markets for photonics"

The AKL - International Laser Technology Congress 2024 fully confirmed its reputation as the leading forum for the European laser industry: There were 525 participants and 81 speakers from 21 countries, a fully booked exhibition accompanying the conference and 60 "Laser Technology Live" demonstrations in the laboratories of the Fraunhofer Institute for Laser Technology ILT and RWTH Aachen University. The congress focused on innovations for established laser applications as well as potential billion-euro markets of the future – including cyberphotonics, quantum technologies and laser-ignited inertial fusion energy (IFE). Once again, the Gerd Herziger Session was a highlight.

"We have not finished researching the laser. On the contrary – 60 years after its invention – things are just getting started!" said Prof. Constantin Haefner, Director of the Fraunhofer Institute for Laser Technology ILT in Aachen, in his closing speech at AKL'24. Looking ahead, he sees huge, completely untapped markets for photonics with sales potential of many hundreds of billions of euros: "Quantum technologies, sustainability, secondary sources, cyberphotonics and inertial confinement fusion." Haefner's list also reflected the top topics of the AKL - International Laser Technology Congress, which attracted 525 participants, 81 speakers and 52 exhibiting companies from 21 countries to Aachen last week, from April 17 to 19, 2024.

Digitalization and AI influence value creation and business models

One topic was omnipresent in the three-day lecture program: Artificial intelligence (AI) is opening up new horizons for research institutes, laser system providers and their users. Indeed, AI is becoming a highly effective tool, especially when combined with dynamically advancing digitalization and ever more closely meshed sensory process monitoring. This is because masses of data are generated along industrial process chains, which companies can process into information with added value thanks to AI. During the Gerd Herziger Session at AKL'24, Fraunhofer ILT Director Haefner discussed what this means for value creation and business models in laser technology with three top managers from the industry: Dr. Hagen Zimer, Board Member and CEO of Laser Technology at TRUMPF SE + Co. KG in Ditzingen, Dr. Christoph Rüttimann, CTO of Bystronic Group in Niederönz (CH) and Dr. Christopher Dorman, the Executive Vice President of the COHERENT Lasers Business.

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Haefner began by pointing out the opportunities cyberphotonics can offer the industry. "As Fraunhofer ILT, we will continue to develop our established expertise in the application of laser technology and optics but expand it to include digital dimensions and the rapidly increasing possibilities of artificial intelligence (AI)," he said. As it is foreseeable how deeply and quickly AI will change value creation in photonics, Fraunhofer is adapting it without hesitation and without the usual organizational embedding in task forces and strategic mission initiatives. This is because the use of AI is already increasing exponentially, including in photonics, whose players Haefner urgently advised to start using AI without further delay. "Access to data and the ability to derive added value from it with AI is already synonymous with competitive advantages," he warned. In the medium term, there is much more at stake, namely the question of who will control the photonics markets in the future. Suppliers of photonic hardware or software companies, the latter of which only integrate lasers into digital platforms as a commodity and shift the actual value creation to digital services?

Don't let lasers become an interchangeable commodity

Haefner illustrated his thesis with an excursion into agricultural technology. The manufacturers of tractors, combine harvesters and various implements agreed on standardized data interfaces very early on, which their machines, devices and, increasingly, optical sensors use to exchange data and transmit it from the field to the cloud. Digital platforms have emerged from this pool, offering farmers real added value today. Integration that has been thought through to the end – networked, smart and service-oriented – was the basis for fully informed, data-based farm management. The agricultural machine remains the fixed point around which digital ecosystems are formed; in these systems, farmers can find sensor-based, spatially and temporally high-resolution data on fertility, irrigation and fertilizer requirements and the yields of their soil. They can also access weather forecasts, trading prices, fleet management solutions and much more. Fully autonomous agricultural machinery will soon be helping to feed these high-precision, intelligent farm systems with data and implement data-based recommendations for action.

According to Haefner, the photonics industry can create comparable ecosystems by networking its laser systems used worldwide, collecting data and using AI tools to create added value for its customers. "We can use AI to better focus research and development, shorten time-to-market, offer predictive and proactive services and optimize laser processes," he explained. Data science is the enabler for a deeper understanding of laser sources, laser processes, measurement, and sensor data. AI, machine learning and digital twins are expanding the technological repertoire, what in the medium term will enable self-learning machines and first-time-right production. Cyberphotonics could thus provide the key to the "Internet of Sustainable Production," a field that Fraunhofer ILT in Aachen is building with various other institutes, and one

in which a growing database is creating the basis to drive forward innovative process chains for the circular economy.

Fraunhofer ILT itself is already using AI on a broad front: It helps users design optics as well as entire research projects or match simulations with real tests; it is used to optimize processes and to control laser processes on-the-fly so that production errors or defects do not occur in the first place. The aim is to minimize reworking and get closer and closer to first-time-right production. However, with a view to global competition, Haefner posed two questions: "Is the speed we are achieving as an industry sufficient? And are your companies ready for cyberphotonics?"

A pragmatic approach to AI deployment – it's all about "Readiness for Cyberphotonics"

The answers from Zimer, Dorman and Rüttimann were clear. TRUMPF, Bystronic and COHERENT have long been working extensively with AI to advance the networking of processes, products and their organizations in their digital strategies. If necessary, they draw on external expertise from start-ups and research institutes and, above all, from their customers.

Zimer shared Haefner's concern that photonic hardware – "even highly developed lasers and laser systems" – could become a commodity. The photonics industry, therefore, needs to move forward. "Digitalization with embedded systems and sensors is providing an increasingly accurate digital representation of the real world. With AI, we can extract previously inaccessible information from this complex data, which comes from a wide variety of areas," he explained. This means that a tool is now available, one that replicates the neuronal learning processes in the human brain – which have been perfected over the course of evolution – at the speed of light. With these neuronal networks, it is now possible to overcome previous limitations in the understanding of photonic processes. This innovation opens up new potential to optimize products and processes, to automate in-house production and for customers – and even to bring together distributed company data with the help of large language models. In addition to data access, pragmatism is the key: Start pilot projects, explore potential and bring in external expertise where it is lacking. Anyone not yet using AI should start quickly and without major organizational preparation, he advised.

Christopher Dorman agreed. COHERENT, with its three units Material (II-VI), Datacom (Finisar) and Lasers (Coherent), is also not shy when it comes to using AI, especially as it can contribute to solving major challenges. According to forecasts, the demand for computing capacity triggered by AI could account for a tenth of global energy requirements by 2030. "With AI-optimized photonic solutions, we can help reduce this demand," he said. Today, COHERENT uses AI to inspect semiconductors, accelerate

hardware development, achieve efficiency gains of between 30 and 50 percent through AI-supported software coding, and to characterize optics with the help of AI or for smart sensor systems that monitor welding processes. "Because we see the huge opportunities and disruptive potential of this technology, we are determined to make its benefits available to our customers as quickly as possible," explained Dorman.

Benefit quickly and comprehensively from the advantages of AI-driven cyberphotonics

According to Rüttimann, the Bystronic Group follows the same approach. He showed a supposedly simple laser process to cut sheet steel. "We have implemented an AI-based on-the-fly system to adjust the parameters, a system that, in conjunction with a camera system, autonomously finds the settings for the best cutting result with minimal need for post processing." AI reduces costs, adapts processes to changing materials and material batches and automatically guides inexperienced users to the optimum process parameters. "AI thus becomes a problem solver and has great potential for optimizing our customers' laser processes and production planning," said Rüttimann.

Regarding AI's potential, Dorman called for a "Silicon Valley mindset": "We should focus on the opportunities and adapt them quickly." The beginnings of this can be seen in photonics. However, according to Zimer, mainly semi-skilled AI is still being used for quality-driven process optimization. On this basis, he expects that suppliers will initially use the in-depth understanding of processes to achieve higher processing speeds. The evolutionary path will lead to learning machines that will be able to control machining processes on-the-fly based on highly developed real-time inline sensor technology. "Then we will see very rapid market penetration," he said. Rüttimann shares this assessment. In the fully automated, smart factories of the future, AI will regulate and control processes on a broad front.

To maintain a leading role in this world, we will need to focus our mentality: Doing instead of procrastinating; focusing on opportunities instead of calling for regulation in fear of the risks. This is exactly how Fraunhofer ILT is proceeding. "AI is the first field of technology that we are tackling without setting up a task force," explained Haefner. The aim is to use the high development momentum to quickly and comprehensively exploit the advantages of AI-driven cyberphotonics in its own research projects and to make them usable for customers from industry as application-oriented research services.

Image 1:
Discussion round with the speakers in the Gerd Herziger Session of the AKL'24.
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Image 2:
Prof. Constantin Haefner opened the Gerd Herziger Session with his presentation entitled "Effects of digitalization and AI on value creation and business models in laser technology".
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Image 3:
Dr. Christoph Rüttimann, CTO of Bystronic Group in the panel discussion of the Gerd Herziger Session.
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Image 4:
Dr. Hagen Zimer, Board Member and CEO of Laser Technology at TRUMPF SE + Co. KG in the panel discussion of the Gerd Herziger Session.
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Image 5:
Dr. Christopher Dorman, Executive Vice President of COHERENT's laser business, discusses the impact of digitalization and AI on the photonics industry.
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