INNOVATION AWARD LASER TECHNOLOGY

Finalists 2024

INNOVATION AWARD LASER TECHNOLOGY 2024

AKL
ARBEITSKREIS
LASERTECHNIK e.V.

ELI European Laser Institute

Dear participants of the ceremony,

What drives people to innovative excellence in our institutions and companies? Is it the desire to solve a given task as optimally as possible using the latest technology? The inherent power of the engineer to constantly improve the status quo? Internal corporate goals? External competition? Is it the conviction of providing people with better living conditions thanks to innovative developments? Or is it the pure ambition of many technology experts? Probably, there is a little of everything.

Innovators are usually self-motivated and exceptionally effective people who use their creativity, skills and will to transform new ideas into concrete products, tools, processes and services. And yet, in highly advanced fields such as laser technology, the expertise and the equipment of a single expert rarely suffices to convert an idea into practice.

More often, through the interaction of several experts in a well-coordinated team, do relevant developments occur. When the invention is rewarded because the market responds positively, the innovation has succeeded.

By bestowing the Innovation Award Laser Technology, we want to distinguish exactly those innovators who have accompanied an invention from research through development to the market launch within the field of production-oriented laser technology. Thanks to their innovations each of the three finalist teams of the Innovation Award Laser Technology 2024 has contributed to the advancement of science and technology significantly. They deserve our thanks and recognition. Finally, we would like to thank the jury members for their commitment and wish you many inspiring ideas for your own developments.

Dr. Alexander Olowinsky
(Chairman of the European Laser Institute ELI e.V.)

Ulrich Berners
(Chairman of the Arbeitskreis Lasertechnik AKL e.V.)

THE JURY 2024

Dr. Lutz Aschke
Photonics System Group, Krailling, Germany

Dr. Willem Hoving
Photonics Consultancy, Geldrop, Netherlands

Dr. José Antonio Ramos de Campos
LASEA Belgium, Seraing, Belgium

Dr. Pavel Bakule, ELI Beamlines Facility, Dolní Břežany, Czech Republic

Dr. Alexander Knitsch, TRUMPF Laser- und Systemtechnik GmbH, Ditzingen, Germany

Pablo M. Romero
AIMEN, O Porriño, Spain

Dr. Guido Bonati
FISBA AG, St. Gallen, Switzerland

Eric Mottay
h-nu, Bègles, France

Dr. Markus Kogel-Hollacher
Organizer | Arbeitskreis Lasertechnik AKL e.V.

Dr. Stefan Hengesbach
QuiX Quantum B.V., Enschede, Netherlands

Prof. Juan M. Pou Saracho
Universitade de Vigo, Vigo, Spain

Prof. Stefan Kaierle
Organizer | European Laser Institute ELI e.V.

www.innovation-award-laser.org

INNOVATION AWARD LASER TECHNOLOGY 2024

Objectives

The Innovation Award Laser Technology is an European research prize awarded at 2-yearly intervals by the associations Arbeitskreis Lasertechnik e.V. and European Laser Institute ELI e.V. The award can be conferred on an individual researcher or on an entire project group, whose exceptional skills and dedicated work have led to an outstanding innovation in the field of laser technology. The scientific and technological projects in question must center on the use of laser light in materials processing and the methods of producing such light, and must furthermore be of demonstrable commercial value to industry.

Selection procedure and finalists

A shortlist of best candidates is compiled by an international jury consisting of ten members recruited from industry and the research community. The prize winner, as well as the second and third placed, are then selected as finalists by the jury on the basis of merit. The prize-winner will receive the sum of 10.000 € in recognition of his work and be furthermore awarded the title of “AKL Fellow” and “ELI Fellow”.

THE PROJECT

Members of the project team

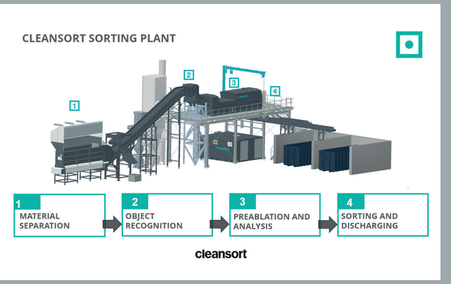
- Edwin Büchter, cleansort GmbH, Rösrath, DE (Team Representative)
- Philipp Soest, cleansort GmbH, Rösrath, DE
- Dr. Winfried Barkhausen, cleansort GmbH, Rösrath, DE
- Josef Tholen, Clean-Lasersysteme GmbH, Herzogenrath, DE

Areas of application

Areas of application are the metal processing industry, manufacturers of aluminium and aluminium products as well as companies in the recycling and reusable materials industry. Sorting and the associated utilisation of scrap as a raw material creates considerable opportunities to use even mixed metal scrap as a recyclable material and feed it directly into the cycle. Several systems are already in use in the recycling industry.

Technological impact

The cleansort process is the industrial solution for recycling metallic materials without downcycling through mixing. Whereas metal scrap was previously mostly sorted manually, cleansort technology allows these processes, the added value and the secondary materials to be kept in Germany, a high-wage country. The technology is also leading to intensive research and innovation initiatives in the recovery and recycling industry and among manufacturers of recycling technology.



Sorting machine for direct recirculation, © cleansort GmbH.

Cleaning, analysing and sorting scrap metal in a single step, © cleansort GmbH.

Recycling of recyclable materials with high throughput, © cleansort GmbH.

1st PRIZE – CLEANSORT GMBH

Laser-based sorting systems for resource-saving recycling of recyclable materials

Edwin Büchter, Managing Partner, cleansort GmbH Rösrath, Germany

Cleaning, analysing and sorting scrap metal in one step

The cleansort process for laser-based real-time analysis of surface-contaminated scrap sets new standards in the recycling of recyclable materials. The development combines laser ablation with laser spectroscopy to sort large mass flows according to their alloy content, thus enabling the direct recycling of valuable materials.

The process, which was developed in cooperation with Clean-Lasersysteme GmbH and brought to market maturity by cleansort GmbH, is able to analyse the quantitative alloy content of a scrap piece within a few milliseconds and sort it using air-pulse technology. Firstly, a high-power laser cleans a small area on the surface of a scrap piece in order to carry out laser-induced plasma spectroscopy (LIBS) with the same laser on the previously cleaned area in the second sub-process. This allows the alloy content of the material to be determined.

The three measuring techniques, combined for the first time in this form, have been linked together by intelligent software and computer technology working in real time in such a way that the technology can be cascaded modularly not only individually "one after the other", but also in parallel to what are now belt widths of up to 2 m (industrially 1.6 m). After measurement and analysis, the scrap piece can then be ejected at the centre of mass using a highly dynamic air pulse technology, thus separating the desired alloys from unwanted parts.

The entire ablation and analysis process takes just six milliseconds with a success rate of over 93 % and highest sorting and detection quality.

The use of recycled materials increases resource efficiency and in many cases reduces material and energy costs as well as greenhouse gas emissions. Modern high-performance metallic materials are characterised by precisely coordinated alloy proportions. In order to increase the proportion of recycled material ("recycled content") in these materials, it is therefore necessary to precisely determine the alloy composition of the scrap used. The cleansort process works with high productivity rates and is therefore both resource-saving and economical. The potential for the process is huge: from the automotive and aviation industries to waste incineration plants - scrap is generated in large quantities.

In general, all types of metal can be sorted in the circular economy process chain and thus recycled by type and without loss. Aluminium in particular not only has enormous economic potential, but also a high CO_2 savings potential. Compared to primary production, around 95 % of energy can be saved.

A single cleansort system, for example, can save up to 291,000 MWh of electrical energy and over 126,000 tonnes of CO_2 every year. This corresponds to almost the entire private energy consumption of all the inhabitants of the city of Aachen.

THE PROJECT

Members of the project team

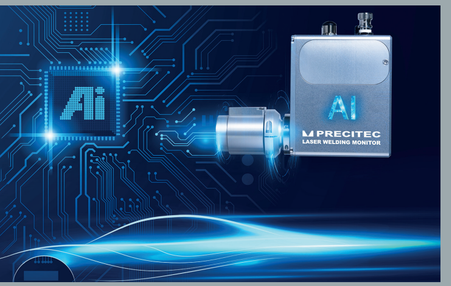
- Dr. Jan-Philipp Weberpals, AUDI AG, Neckarsulm, D (Team Representative)
- Daniel Böhm, AUDI AG, Neckarsulm, DE
- Matthias Spängler, AUDI AG, Ingolstadt, DE
- Dr. Jens Reiser, Precitec GmbH & Co. KG, Gaggenau, DE
- Martin Krause, Precitec GmbH & Co. KG, Gaggenau, DE
- Timur Demirbas, ehemals Precitec GmbH & Co. KG, Gaggenau, DE

Areas of application

Various sectors of industry like automotive, aeronautics and space, ship and rail transport, electronics and consumer technology will benefit from the innovation. The novel holistic laser beam welding process with AI embedded sensors for cell contacting of battery modules finds its first use in module production for the Audi Q6 e-tron and the A6 e-tron.

Technological impact

- New products like HV-battery modules
- New product features due to highest weld seam quality with innovative welding processes
- Reduced process costs because of quality control loop with batch size "1"
- Shorter development lead time for follow-up projects based on broad fundamental process knowledge
- Improved working conditions through component-specific error display in absolute physical values
- Improved quality assurance with AI embedded sensor



AI embedded Laser Welding Monitor LWM, © Precitec GmbH & Co. KG.

Audi Q6 e-tron, © AUDI AG.

Industrial prismatic cell battery pack, © Precitec GmbH & Co. KG.

2nd PRIZE – AUDI AG

Holistic approach for laser beam welding for cell contacting of battery modules with highest quality

Dr. Jan-Philipp Weberpals, expert for laser beam processes in car body construction and electromobility, AUDI AG, Neckarsulm, Germany

Motivated by the global warming, the automotive industry is in the middle of the transformation from the use combustion engines to electric driven cars. The battery is one major cost driver and has overall a high quality requirement on the joining technology. Each weld must not only meet mechanical requirements, but above all electrical conductivity is a property that must comply 100 % with the specifications. The electric driven cars are close to emission free, therefore the focus needs to stay on a emission free manufacturing. This work has been motivated by the environmental goals of the AUDI AG and the VW Group to achieve an CO_2 neutral production by 2035.

Audi has been using the newly developed holistic laser beam remote welding process with component position detection and seam visualization for module production and in particular cell contacting as a key process for electrification in prototype production since August 2022. Once the prototype phase has been completed across all sample construction stages, the process will be transferred to series production facilities.

All component, fit, clamping and positioning tolerances from the preceding process chain are compensated for by component position detection and individual positioning of the weld seam. With this symbolic "resetting" of tolerances, the welded seam joints can be optimally positioned from several points of view to maintain optimum current conduction in the cell contact and consequently in the overall battery system. This in turn enables the high performance of the overall battery system to be guaranteed.

Beam oscillation and the novel welding strategy using high-speed welding and juxtaposition of weld tracks to produce a closed-area bond surface offer versatile possibilities for influencing process quality, product design and system layout. The large process windows regarding the individual parameter influences, but also their combinatorics, enable a very high direct run rate. To further reduce process time, the novel welding process offers direct scalability between feed rate, number of adjacent weld tracks and the resulting process time per contact point with constant attachment area. Depending on the system design, this speed increase can be used to minimize the cycle time and thus increase the output rate. In addition, the number of welding systems used can be scaled and profitably converted into savings in investment costs.

AI-based evaluation of the process signals to extract absolute physical values allows a 3D fingerprint to be reconstructed for each weld. The direct feedback of the system technology to the plant in the form of component strength, gap dimension between the joint components, the welding depth and thus the contact quality of the cell contact minimizes the quality control loop to batch size "1". In the event of a fault, the system is stopped immediately and the cause of the fault is eliminated directly by assigning the cause of the fault to the corresponding contact point, thus keeping the reject rate low.

The advantages of the developed overall system are the sum of the advantages from the individual developed subcomponents. Overall this innovation will further increase the quality by reducing the manufacturing cost and plays an important role in reducing the CO_2 footprint of the battery manufacturing process by decreasing the scrap rate in this high volume application. This clearly shows the importance of this technology for Audi.

THE PROJECT

Members of the project team

- Gwenn Pallier, Cailabs, Rennes, FR (Team Representative)
- Dr. Adeline Orieux, Cailabs, Rennes, FR
- Dr. Ivan Gusachenko, Cailabs, Rennes, FR
- Thibaut Atché, Cailabs, Rennes, FR

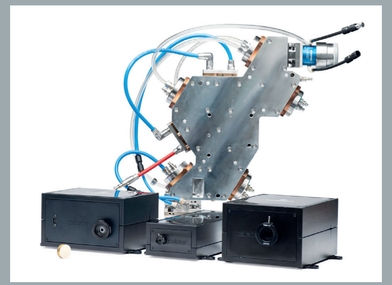
Areas of application

CANUNDA has demonstrated commercial benefit on three main laser-processing applications: Additive Manufacturing, Laser Beam Welding and Micro-processing. The improvements provided to those applications benefit to multiple sectors of the industry: aerospace, automotive, defense, metal working, electronic or luxury... Beam shaping solutions provided by CANUNDA generally enables new processes, new parts, faster processes, and better-quality processes to those sectors.

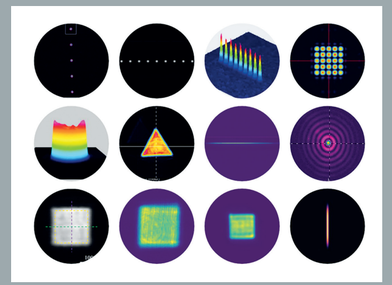
Technological impact

The CANUNDA beam-shaping solutions offer unparalleled flexibility in shaping to meet the specific challenges of each laser process, compatibility with all types of lasers, and robust industrial solutions, particularly through an extended depth of field. CANUNDA aims to be a game changer in numerous fields: increasing surface texturing speed by 200 times, making Laser Powder Bed Fusion printing 10 times faster, and halving scrap rates in laser welding for e-mobility applications.

The CANUDA team, © Cailabs.



CANUNDA off-the-shelf Products for micro and macro processing, © Cailabs.



Flexibility of the shapes provided by CANUNDA, © Cailabs.

3rd PRIZE – CAILABS

CANUNDA – UPSCALING LASER PROCESSING WITH BEAM-SHAPING

Gwenn Pallier, Product Line Manager, Cailabs, Rennes, France

Cailabs has been founded in 2013 to commercialize a unique beam-shaping technology, Multi-Plane Light Conversion (MPLC), which originated in 2010 at the Laboratoire Kastler Brossel in Paris, France. Initially aimed at telecommunications, MPLC has been adapted for laser processing since 2018 with the CANUNDA product line and has already significantly benefited to this industry.

By optimizing the energy distribution, laser beam-shaping meets the challenges of laser processing mainly in two areas: improving the speed and enhancing the quality of the laser processes.

Traditional laser beams struggle with the welding of materials like copper and aluminum, crucial for e-mobi-lity, due to issues like porosity and spatters, which can be solved with an appropriate beam-shaping.

In Additive Manufacturing processes like L-DED and L-PBF are limited in their efficiency, and hot-cracking limits the powder material processable as well. This limits the addressable markets and can be addressed with beam-shaping.

Micro-machining reaches a speed limit with simple Gaussian beams not providing the requested quality at high power and quality aspects, such as drilling homogeneity or edge roughness, are limited by the Gaussian beam as well. These can be improved through beam shaping.

The innovation that CANUNDA brings to the world of laser processing is the provision of a unique tool for a real upscaling of laser processes:

- Offering robust solutions compatible with industry requirements: CANUNDA solutions offer the largest Depth of Field of the beam-shaping technologies turning challenging processes into forgiving ones. CANUNDA also provides a unique passive beam-stabilization key for robust micro-processing applications.
- Operating at high average and peak power: CANUNDA with a fully reflective implementation is the only solution compatible with the most powerful CW and Ultra-Short Pulse lasers today and even tomorrow.
- Providing custom shaping: Every industry challenge is unique, with unique materials and constraints, and the shaping to address them must be customized, which is possible with the CANUNDA solutions.

CANUNDA's beam shaping solutions have already brought benefits to Cailabs' customers, such as technology leadership, increased production capacity, improved machine profitability, creation of new machines, replacement of non-laser processes, facilitation of new laser processes and simplification of existing ones. These improvements are possible by the reduction or scrap rates in metal welding (/2), the speeding up additive manufacturing processes (x10) or surface texturing (x200), or the reduction of drilling taper (/2). CANUNDA's MPLC technology enables these advancements and contributes to more efficient and higher-quality laser processes.

FORMER FINALISTS

2016 – Philips GmbH Photonics Aachen,
© Fraunhofer ILT / Andreas Steindl.

2018 – Laserline GmbH,
© Fraunhofer ILT / Andreas Steindl.

2020 – TRUMPF Werkzeugmaschinen GmbH & Co. KG,
© Arbeitskreis Lasertechnik e.V. / Andreas Steindl.

2022 – PRIMES GmbH,
© Arbeitskreis Lasertechnik e.V. / Andreas Steindl.

2016

1st Prize
VSCEL ARRAYS: A NOVEL HIGH-POWER LASER TECHNOLOGY FOR "DIGITAL THERMAL PROCESSING"

Dr. Armand Pruijmboom (Team Representative)
Philips GmbH Photonics Aachen, Aachen, Germany

2nd Prize
LASER BEAM REMOTE WELDING OF ALUMINIUM FOR AUTOMOTIVE LIGHTWEIGHT DESIGN

Dr. Jan-Philipp Weberpals (Team Representative)
AUDI AG, Neckarsulm, Germany

3rd Prize
UVBLADE – FLEXIBLE DISPLAY MANUFACTURING BY THE METER

Dr. Ralph Delmdahl (Team Representative),
Coherent LaserSystems GmbH & Co. KG,
Göttingen, Germany

2018

1st Prize
MULTI SPOT MODULES TO IMPROVE JOINING PROCESSES DUE TO TAILORED SPOT GEOMETRIES

Dr. Axel Luft (Team Representative)
Laserline GmbH, Mülheim-Kärlich, Germany

2nd Prize
MULTI PARALLEL ULTRAFAST LASER ABLATION FOR LARGE SCALE ULTRAPRECIOSION MANUFACTURING

Dr. Gerald Jenke (Team Representative)
Saueressig GmbH + Co. KG, Vreden, Germany

3rd Prize
RAIO DSS: A HIGH FLEXIBILITY DYNAMIC BEAM CONTROL SYSTEM FOR LASER HEAT TREATMENT AND RELATED HIGH POWER LASER APPLICATIONS

Alejandro Bárcena (Team Representative)
Talens Systems S.L. Etxe-Tar Group, Elgoibar, Spain

2020

1st Prize
ACTIVE SPEED CONTROL – CAMERA-BASED SENSOR SYSTEM FOR CLOSED-LOOP FEED REGULATION IN LASER CUTTING

Dr. Boris Regaard (Team Representative)
TRUMPF Werkzeugmaschinen GmbH & Co. KG,
Ditzingen, Germany

2nd Prize
NEW LASER SOLUTION FOR DEFUSING UNEXPLODED (UXO) BY THE USE OF A DISPOSABLE 3D PRINTED TOOL HEAD

Dr. Oliver Meier (Team Representative)
LASER on demand GmbH, Burgdorf, Germany

3rd Prize
UNLIMITED FLEXIBILITY FOR SHORT PULSE LASER APPLICATIONS

Dr. Maik Frede (Team Representative)
neoLASE GmbH, Hannover, Germany

2022

1st Prize
SCANFIELDMONITOR (SFM)

Stefan Wolf (Team Representative)
PRIMES GmbH, Pfungstadt, Germany

2nd Prize
INNOVATIVE SURFACES USING HIGH-SPEED LASER-BIOMIMETICS

Dr. Tim Kunze (Team Representative)
Fusion Bionic GmbH, Dresden, Germany

3rd Prize
FINALLY UNITED: OCT-BASED PROCESS CONTROL AND ON-THE-FLY REMOTE LASER WELDING IN ONE TOOL

Thibault Bautze-Scherff (Team Representative)
Blackbird Robotersysteme GmbH,
Garching bei München, Germany

EUROPEAN LASER INSTITUTE ELI E.V.

European Laser Institute ELI e.V.

Optical technology is taking an increasing hold on all domains of industry and science. Europe already possesses a strong position in this field by virtue of its numerous experts and excellent research and development facilities. Nevertheless, it has been realized that there is an urgent need to link the existing sources of know-how and expertise, and to enhance the performance of joint research activities.

This shortcoming has been recognized and therefore the European Laser Institute was founded in 2003 through an EU-funded initiative. The ELI mission is to strengthen and further enhance Europe's position in the field of laser technology. In addition, ELI aims to raise public awareness of the significance and prospects of the European laser technology industry.

ELI is a network composed of the European leading research organizations and medium-sized companies. It builds a bridge between industry and research facilities and pushes international cooperation especially in the field of EU research. ELI also creates adequate platforms by organizing conferences, workshops and summerschools.

Executive board

- Dr. Alexander Olowinsky, Fraunhofer ILT, Aachen, Germany
- Dr. Markus Kogel-Hollacher, Precitec GmbH & Co. KG, Gaggenau, Germany
- Prof. José Luis Ocaña, Universidad Politécnica de Madrid, Spain
- Prof. Andreas Ostendorf, Ruhr-Universität Bochum, Germany
- Pablo Romero, AIMEN, Spain

For further information please visit:
www.europeanlaserinstitute.org

ARBEITSKREIS LASEERTECHNIK AKL E.V.

Arbeitskreis Lasertechnik AKL e.V.

Arbeitskreis Lasertechnik AKL e.V. is a registered non-profit association formed in 1990 by a group of companies and private individuals aiming to pool their experience and conduct joint public-relations activities in order to spread the use of laser technology in industry and promote the sharing of scientific ideas. The "Innovation Award Laser Technology" aims to reward excellent achievements in applied research and outstanding innovation in the field of laser technology and to shine a spotlight on their authors.

In 2024, more than 200 laser experts and enthusiasts were signed up as active members of the AKL network. The association's activities include disseminating information on innovations in laser technology, organizing conferences and seminars, compiling educational material dealing with laser technology, stimulating the interest of future young scientists, and providing advice to industry and research scientists on questions relating to laser technology.

Executive board

- Ulrich Berners (Chairman)
- Prof. Constantin Häfner (Vice Chairman)
- Dr. Claus Schnitzler (Treasurer)
- Dr. Markus Kogel-Hollacher (Executive Director)

For further information please visit:
www.akl-ev.de

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