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LASHARE

SHARING LASER EXPERTISE

Innovation Through Laser-Based Equipment Assessments

USR = End User
RTD = Research Partner
SUP = Supplier

LASHARE

Laser-based Equipment Assessment was invented in 2013 with the start of a European research project under the acronym LASHARE. It received support from the European Commission sevenths framework program for research and development. From the start, six of the most renowned technology centers on laser technology teamed up to deliver suppport to innovative findings in the labs of SMEs towards an industrial exploitation of the results.

One of the driving principles in LASHARE are the assessment teams. As a first adopter, an industrial user defines his requirements to the anticipated solution. This ensures that the final product will be market ready with a clear demand on functinality. In the role of technological backbone and facilitator of experimentation and research, the competence centers play a vital role in the overall development and conduction of the assessment. The largest benefit however is for the SME that aims to develop his idea towards a robust prototype. Within the framework of the laser-based equipment assessment, his idea is challenged, elaborated, tested and validated.

LASHARE as a platform continues this success story. Partners from industry and SMEs are offered support along the path from laboratory to the market. Within this engagement, the involvement itself is decided by every stakeholder individually. From observer status to contributor, each partner of an assessment team can define its role individually.

_definition of requirements
_implementation planning
_identification of research and development tasks
_execution of development and testing
_reporting of result to facilitate further funding and development

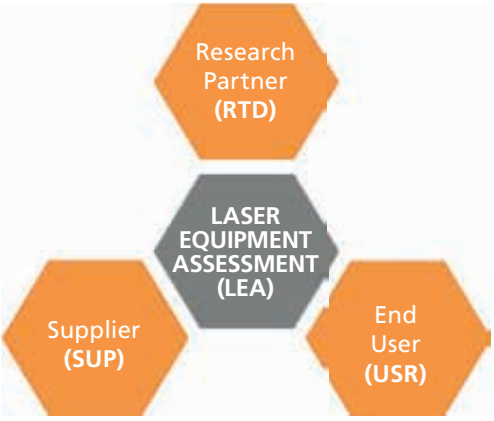

Fig. 1 LASHARE Assessment Trio

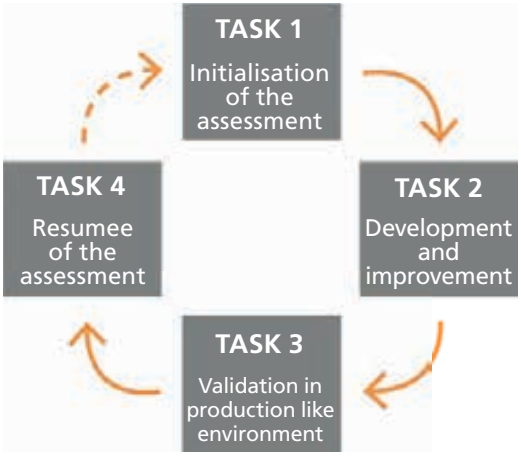

Fig. 2 LASHARE Assessment Cycle

ENHANCING TECHNOLOGY READINESS LEVELS

LASHARE has conducted 28 assessments on laser based equipment. Through an assessment cycle, the teams of industrial end users (USR), SME suppliers (SUP) and research partners (RTD) strive to enhance the technology readiness level of the solutions.
The final goal of the Laser-based Equipment Assessments (LEAs) is, to accelerate development from the laboratory towards a final demonstration in a production-like environment.
The resumee as the last step of the assessment cycle provides recommendations for future exploitation of the assessment. It identifies gaps between the vlidated status of the prototype and the market ready solution and gives suggestions on how to close them. This resumee can be used as a basis for future projects or for access to finance, be it a local bank or venture capital.

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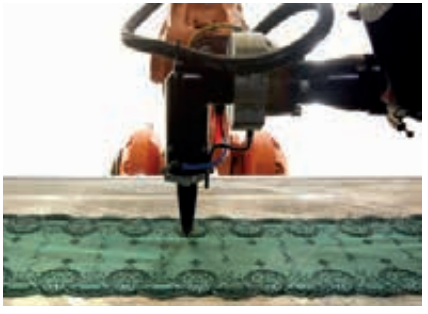
WP700

USR = End User
RTD = Research Partner
SUP = Supplier

ALPS LEA 301

Vision-based laser cutting for patterned fabrics



SUP SIMAUPRO

RTD aimen TECHNOLOGY CENTRE

USR Selmark lingerie

CHALLENGE

The major goal of ALPS is a machine vision system that alleviates fixing and positioning requirements of highly deformable and patterned fabrics and enables cutting without any prior marking. The overall aims are to decrease cost and complexity of the fixing system, to increase cutting performance and overall throughput for all relevant batch sizes, while ensuring high system usability and reliability.

BENEFIT

The ALPS approach removes the need to produce cutting dies for the production of clothes. It aims at a machine vision-based cutting system capable of instantly producing different pieces by a simple design and transfer procedure.
Vision guidance greatly reduces positioning requirements for deformable fabrics of variable thread thickness. ALPS will demonstrate the capability of machine vision to cope with fabric deformation, thread thickness and lace positioning and guide the laser beam while controlling laser parameters.

This will extend the current machine market to a new breed of machines for flexible and individualised manufacturing. Textile industry as the user will have the opportunity to adopt laser cutting for deformable decorated fabrics at virtually no extra cost.
Increased productivity, improved production rate and enhanced quality control are accompanied by waste reduction and the ability to offer individualised products at competitive cost, even at a batch size of one.

ACHIEVEMENTS

For SIMPAUPRO, the Laser-Based Equipment Assessment (LEA) has already brought enormous success.
A machine vision system has been developed, validated, and integrated into a commercial laser robot cell. This system makes a straightforward offline graphical programming of the laser cutting process. During online operation it takes control of the process, aligning CAD models of pieces and the lace to cut and adapt the laser parameters to the local properties of the particular lace cut. A highly efficient user interface has been developed, allowing the user to align the contour with lace image. On top of that, end-user SELMARK and supplier SIMPAUPRO have consolidated their competitiveness in their respective fields. SELMARK expects to reduce current fabric waste in semiautomatic operations by 55%, thus immensely lowering cost and overall material waste. Also, worker productivity improves by a factor of 2-4. Supplier SIMAUPRO integrates the technology for SELMARK and other textile companies, hence improving the current market by meeting its demands.

FLAT
LEA 302

Plug-in laser diode module for warm sheet metal forming

SUP monocrom

RTD aimen TECHNOLOGY CENTRE

USR Johnson Controls

CHALLENGE

Enabler of this technology is the integration of a vibration resistant laser diode module directly into a sheet forming machine. It has to deliver 1 kW of power on 1 cm² using direct regular water cooling for operation from 10°C to 40°C which will lead to a reduction of forces in roll forming by 50%. The assessment aims at implementing a totally spring-back-free process with 100% geometric certainty after forming.

BENEFIT

For the user, the application of laser-assisted technology in roll forming provides a way of improving the flexibility in the design of products. It enables a reduction of required mechanical efforts and breakages, and the capability to handle work pieces with higher strengths and thicknesses with the same machine. In combination with an increase in the maximum forming speed, all these enhancements contribute to an increase in productivity.

In relation to the tracks, the results of the project will allow cost-competitive high-volume production of moderately complex applications. This covers a huge portion of the global market with over one million parts per year. The expected ability to produce compact profiles however enables new comfort designs for the high-end markets.

A successful application would open a new and unique market as the new comfort designs cannot be produced with existing technology.

ACHIEVEMENTS

FLAT now offers a higher power density as well as a very advanced control electronic package, including communication, closed loop control, safety and fail-safe features. As a first-grade industrial prototype, the system contains the innovative optical and mechanical design, including beam-forming optics. FLAT has improved in process performance and contributes to an eco-friendly production. Formability has improved, achieving lower spring back while nearly eliminating the cracking risks. The integration into the existing manufacturing facility works successfully. A 3D-model of roll forming line, of the envisaged integration package outline, and a strategy to replace roll forming stations with modular laser heating stations are available. The manufacturing process improves the flexibility in design of product as well as both, reduction of required mechanical efforts and, reduction of breakages. Even more, the product can handle higher strengths and thicknesses with the same machine . That way, maximum forming speed increases as does productivity, resulting in cost-competitiv high-volume products. For end users MONOCROM and Johnson Controls.

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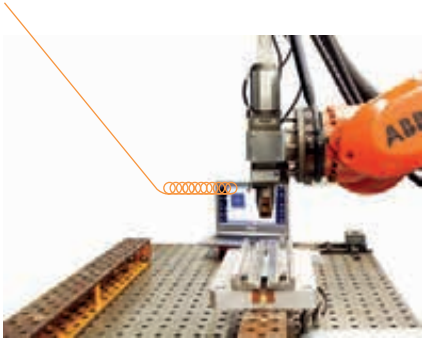
LASPRO
LEA 303

High-speed infrared laser welding monitor and control



SUP NIT New Infrared Technologies

RTD aimen TECHNOLOGY CENTRE

USR CRF CENTRO RICERCHE FIAT

CHALLENGE

The assessment aims at monitoring the IR emission of the weld pool with a repetition rate of 10 kHz. Providing a tool for online detection of process instabilities in laser beam welding is one of the key challenges. Its benefits are received from the implementation of a closed loop control for the laser welding process.

BENEFIT

The focal plane arrays (FPA) developed in LASPRO will enable a new level in laser welding performance and reliability. Looking at the automotive industry, every car has roughly 4000 to 5000 welds which affect performance and safety. 20% of them are done by lasers. LASPRO will enable an increase of the share of laser welding by providing monitoring capability and online control.

- *Enable aesthetical welding without the need of a finishing process, generating a good fit into other assemblies without weld seam interferenc*
- *Realise an increase in stiffness, enhancing the safety of cars*
- *Enable the reduction of flange heights, saving raw material*
- *Optimise speed and productivity*

With the LASPRO focal plane array tool it will be possible to support the personnel in assuring quality which results in a decrease of cycle time and an enhancement in productivity.

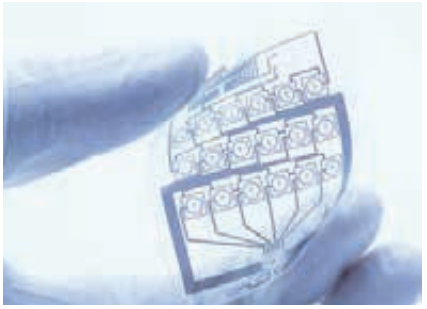
Additionally, the reduction of maintenance activities and a move from scheduled maintenance to maintenance on demand will lead to relevant reductions in production cost and an increase in uptime.

ACHIEVEMENTS

A fast MWIR uncooled camera of NIT was successfully coupled to a standard laser processing head. Repeatability of the process is ensured by defining the defects that shall be detected in this type of laser welding; validation took place in form of posterior geometrical and metallurgical study. All in all, more than thirty welding seams were recorded and monitored. In some configuration, frame rates as high as 2000 Hz were used. The technology has excellent potential for helping to control laser parameters in real time and in line to an efficient performance/ cost ratio. End-user CRF's mission is the development and transferring of innovative systems and features, materials, processes and methodologies to improve the competitiveness of Fiat & Chrysler products. LASPRO enhances the existing technology: Supplier NIT benefits from the development of a specific software for its camera: LASPRO is enhancing its technology even more by developing specific software for NIT camera. This software is able to detect lack of fusion generated by three possible situations:
1) excessive gap between sheets,
2) grease between sheets and
3) small deformation in one sheet. It is able to detect a lack of fusion, something which can be generated.

TEETO
LEA 304

Compact sub-nanosecond laser source for thin film processing



SUP

RTD

USR

CHALLENGE

TEETO is developing laser-based equipment for processing of thin films with a sub-nanosecond laser source. One of its main goals is to provide a price competitive long-term stable laser source. As a result, productivity can be enhanced based on an increase of 30% in average power. The assessment also focuses on implementing a top hat energy distribution for thin film processing.

BENEFIT

TEETO aims to introduce new laser sources into the market of equipment manufacturers and users for the production of organic photovoltaics or organic LED's (OLED). The challenge of achieving a top hat distribution of the energy is also a unique selling point. This entirely new technology will reach the new markets because of:

- *The integration work provided by Alphanov during LASHARE will open the opportunity to test and implement alternative processing strategies.*
- *The process information gathered during this project will help the commercial prospection.*
- *Sub-ns microchip technology which will be able to spread best after the initial penetration enabled by this project.*

Laser patterning with top-hat distribution would bring a lot of benefits, thanks to its flexibility and precision. Moreover, it is a one step process, which can easily be integrated in a roll-to-roll application. With the new equipment, MICEL will be able to provide ready to use indium tin oxide structures on film substrates to its customers at short lead times.

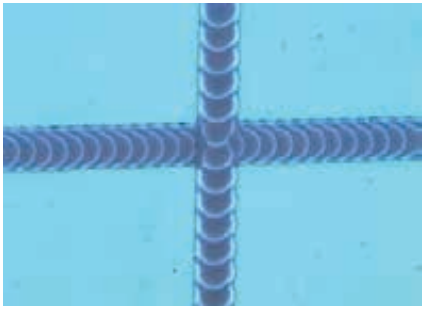
ACHIEVEMENTS

Laser ablation of the TCO layer has shown the advantage over chemical processing technology: it is a one-phase process that offers flexibility and precision. Tests performed at Alphanov consisted of removing TCO of the PET substrate without degradation of the substrate. MICEL wants to implement laser patterning in its industrial process, to add value to its products, and to provide its customers with "readyto-use" ITO films. Another benefit of this project is the ability to supply a reliable replacement technology to ITO. TEEM PHOTONICS' strategy is to provide laser sources at an interesting cost to equipment manufacturers and end-users that would be either OPV / OLED manufacturers. The integration of TEEM PHOTONICS technology could concern at least 50 manufacturing equipments per year in the next 5 years. The integration work provided by Alphanov during LASHARE offers the opportunity to test and implement alternative processing strategies. The process information gathered during this project will also help the commercial prospection.
TEEM Photonics is going to offer more reliable lasers and thus robust processing equipment to these existing and potential partners.

USR = End User
RTD = Research Partner
SUP = Supplier

FCPS
LEA 305

Laser system for flexible CIGS photovoltaic scribing



SUP

SUP

RTD

USR

CHALLENGE

The goal is to provide a process for the scribing of the molybdenum layer (P1), without changing the underlying insulating layer and to enable structuring of CIGS (P2) parallel to (P1) without affecting the molybdenum layer. This allows parallel removal of transparent conducting oxides (TCO) (P3) without sacrificing other layers. The three scribes are characterised by a depth of less than 50 µm at a processing speed of 2 m/s.

BENEFIT

Multitel will assess the use of new pulsed lasers, combining performance and low investment cost to gain expertise on the integration of such lasers into fully controlled machines for solar cell production. In addition to that, Lasea focuses on demonstrating the feasibility of using the new laser sources for thin film solar cell production. The benefits include:

_Provide the end user SSE a set of objectives for photovoltaic scribing.
_Increase the photovoltaic conversion efficiency of modules produced in fully-automated in-line machines to minimise the amount of scribing.
_Reduce the distance between the modules and the amount of damage caused by the heat affected zones on the edges of the grooves.
_Increase the reproducibility of the laser structuring compared to the cuts made by mechanical or chemical methods.
_Enhance the productivity of the manufacturing system by running at speeds of 5-6 m/s.

ACHIEVEMENTS

Supplier Multitel has produced a machine suitable for solar cells manufacturing. Connecting the different layers in a proper way generates electricity from sunlight. What does this process require?
Each layer is scribed in order to define individual cells connected in series. Laser technology proves to be the most efficient and precise tool for that. The successfully implemented laser is capable of providing a laser beam of two different wavelengths: one in the infrared range and the other in the visible range. As of yet, the machine is still in its developmen stage with the goal to optimise the processing speed – for example by using lighter construction and varying shape and size of the mirrors used. The system is designed and manufactured in such a way that it can be easily integrated in Lasea machine.
From an economic perspective, end-user SSE expects an immense reduction of production costs of up to 67 %. Laser-based scribing of solar cells holds the enormous advantage of being less error-prone than mechanical or chemical methods. The system developed in the FCPS assessment can even be applied beyond thin-film solar cells processing in the future.

CUDE
LEA 306

Direct diode laser system for cutting of mild stainless steel

SUP directphotonics

RTD LZH

USR Prima Power

CHALLENGE

The challenge is to develop a 9xx nm diode laser system that robustly delivers 1 kW at 7.5mm*mrad. The diode laser system will provide optical and electrical interfacing for industrial application in the area of cutting and the system will demonstrate diode laser cutting of mild steel up to 6 mm, stainless steel up to 4 mm, and aluminium up to 3 mm.

BENEFIT

Plate cutting is the largest application field in a five billion Euro worldwide market for laser macro machining. Potential applications are laser cutting of different materials and thicknesses like:

_Mild steel up to 6 mm
_Stainless steel up to 4 mm
_Aluminium up to 3 mm

CUDE aims to establish an important milestone by validating the cost/ performance relationship of novel direct diode lasers in an industrial environment. From the supplier side, there is benefit in standardisation and interfacing of technical equipment. This gives the supplier the opportunity to fit in different applications and to break into different markets. The user benefits from the low cost of ownership and simple implementation through standardisation and interfacing. Both DPI and Prima expect to benefit from the predicted growth in this segment of cutting.

ACHIEVEMENTS

Currently, ultra-high brightness diode lasers provide kilowatts of output power with an efficiency of more than 40%. The planned combination of laser sources by wavelengthmultiplexing has been shown for 500 Watts power blocks, measuring a footprint of a notebook. Together with an increase in control speed, this leads to new integration concepts for industrial laser cutting equipment, spurring further optimization of the laser system for ‘plug-and-play’ operations with extended capabilities. Combining the diode design with fast control structures enables power modulation with tens of kilohertz. Metal processing can be improved towards higher cutting speeds, cutting quality, increased energy efficiency and lower maintenance requirements. Thus, lower costs and higher process quality can be expected. The new generation of 3D–laser cutting machinery will be equipped with direct laser diode, increasing the competitiveness of the laser system. Supplier Direct Photonics benefits from standardisation and interfacing of technical equipment, enabling him to fit in different applications and to emerge into different markets. End-user Prima Power benefits from low cost of ownership and simple implementation through standardisation and interfacing.

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SUP = Supplier

MOBILLAS
LEA 307

Mobile laser system for on-site material processing

SUP

RTD

USR

CHALLENGE

Providing a fully integrated and portable laser system for on-site cutting and welding is one of the essential goals. MOBILLAS intends to enable mobile and safe high-power laser processing in the field, for example in ship yards. Thus, it can be applied to large structure manufacturing with thicker materials. Mobile operation of laser equipment however challenges the requirement for absolute laser safety, especially if training efforts have to be kept at a minimum.

BENEFIT

The new mobile laser technology transfers semi-automated and automated processing to mobile applications, offering alternatives to the dominant use of high heat input welding, like gas metal arc welding and to fully manual joining procedures like screwing.
It helps to improve quality by using self-guiding systems and it decouples personal skills of even well-trained personnel through a sensor equipped and controlled machine with external and internal detectors oriented towards the given part geometry.
This saves time and money in repair and production, thus increases efficiency.
Modular design of large scale tooling and construction is unthinkable without this kind of technology.
The concept is independent from the respective laser process. Different potential markets have been identified:

_Large scale aerospace tooling
_Heavy industries, chemical and pharmaceutical equipment
_Power plants
_Trains and coaches
_Shipbuilding
_Mechanical engineering like cranes and construction machines

ACHIEVEMENTS

Occupational safety can now be ensured thanks to the successful integration of a second, sufficiently long axis and the corresponding adaptation of the system housing. From an economic point of view, several accomplishments stand out: Weight reduction, which greatly improves the manageability and portability of the system, as well as the design and realization of the two-axis system. Consequently, the three processes welding, cutting and ablation can function in a highly efficient way. Applying 3D-printing technology to manufacture mounts and structural parts, moved masses and the overall weight of the mobile laser processing system can be reduced.

TWOMICRO
LEA 308

Two micron laser source for light-weight materials and medical sector

SUP PRIMES

SUP LISA LASER PRODUCTS THE 2nicron COMPANY

RTD LZH LASER ZENTRUM HANNOVER e.V.

USR trotec

CHALLENGE

The assessment aims to provide a two micron laser source with power and beam profile stability. The required achievement is to feed 200 Watts of stable power into a 125 µm fibre. This performance will be validated against the reproducibility of scribed grooves and other processes.

BENEFIT

TWOMICRO aims to develop laser sources at a wavelength which is rarely commercially available. The demand for such laser sources with a high potential market volume comes not only from cutting applications but arises from the suitability to process organic material. Therefore, offering lasers with output wavelengths in the 2 µm range promises a high sales potential helping the medical sector to develop new applications and to provide new services to humans.

With respect to cutting, the two micron sources enable smaller focus diameters compared to conventional CO2 lasers, which minimise groove widths as well as the cutting scrap. Exploitation with respect to minimised cutting scrap, sharper cutting edges and easy three dimensional processing of complicated polymer profiles will be enabled. The need for such laser sources directly implies a need for characterisation equipment, which is also covered by TWOMICRO.

ACHIEVEMENTS

So far, TWOMICRO can report the successful implementation of collimator for the 2µm range at power ratings in excess of 150 Watts. A first laser source with an emission spectrum centered at 1983.3 nm has been demonstrated at an average output power of 52.6 W.
A camera-based beam measurement device with an optic for the target waveband has been developed. The system allows broader measurements. For the power combination of several laser sources a simulation was developed to model the feed of seven sources into one distinct signal fiber. The model considers a tapered section of the signal fibers bonded to a multimode fiber with variable length. Due to varied fusion parameters it was possible to successfully develop a tapered fiber bundle without air inclusions. The developed combiner had a transmission higher than 74 % in the wavelength range between 1.5 µm and 2 µm for each fiber in the bundle. Initial processing experiments were conducted with the laser prototype on polymer plates. The processed material showed maceration while the laser was emitting continuously, generating complex structures on plane polymer plates. Supplier LISA will offer its laser system with a price in the range of 10.000 €, expecting to sell up to 200 laser systems a year with an expected volume of sales exceeding 10 million € (70 % market share). Supplier PRIMES expects a high demand for its beam propagation measurement in markets like communication, medicine, avionics and other transportation trends. End-user TROTEC will integrate 2 µm laser sources to its material processing machines, resulting in an advanced light source for processing of organic materials in addition to CO2 Lasers, thus providing a more precise material processing.

USR = End User
RTD = Research Partner
SUP = Supplier

HELIDRILL LEA 309

Helical laser drilling system for micro vents and conducts

SUP S&F Systemtechnik GmbH

RTD Fraunhofer ILT

USR P&G Braun Oral-B

CHALLENGE

The adjustment of a number of optical components determines the beam guiding for different hole geometries. To use it in an industrial environment, a high performance control system is required which enables precise, robust and repeatable adjustment. Users require a prolonged mean time to maintenance and adjustment procedures have to be simplified. Application-specific space constraints of the tool require smaller and remote focusing modules to drill at currently inaccessible positions. Another challenge is to provide a convenient user interface with process monitoring capabilities for reliable processing in a diverse set of system configurations.

BENEFIT

The efforts which are invested into the technological robustness of the system are driven by the requirements of the industrial user, P&G / Braun. In their tool shop, precision micro holes for injection moulding tools are needed to realise innovative injection moulding processes. The use of those new tools and processes opens the possibility to realise products with new features that provide unique selling points in the market.The HELIDRILL system is a strategic product on the technology roadmap of S&F. Within the growing market for high-precision ultrafast laser processing, S&F will extend its product range by this drilling technology.

Besides its use for vents, the technology can also be applied to areas such as technical filters and semiconductor devices.

ACHIEVEMENTS

First, the base area of the main module with the rotator has been reduced and several minor dimensional variations have been fixed. The focusing module can now be separated from the main module in order to be used remotely within space-constrained applications. The overall design was extended by a coaxial camera module that includes the last 90° beam bender. With this camera the user is able to monitor the work piece surface via HMI and the process and holes can safely be placed at the right position. All three focusing modules can be used directly at the main module, the camera module or remote. Slim and robust design of focussing modules leads to maximum access to possible drilling positions without interfering with the work piece. The mount of the image rotator was partly redesigned and adjustment sensitivity was increased. The electrical assembly of Helidrill has been finished as well, with a partial wiring of the motor to the P&G Oral B production plant. The software programming of basic motor functions has also been completed. Aditionally, the motors can now be manually set up and operate via the HMI in a production environment.

LAP3D
LEA 310

Laser processing system for stitching structured patterns on large 3D parts

SUP rofin ROFIN-BAASEL ESPAÑA

RTD TECHNOLOGY CENTRE CARTIF

RTD Fraunhofer ILT

USR MAIER

CHALLENGE

The assessment will implement a mechano-optical solution to process curved surfaces with an acceptance angle of up to 270°. The challenge is to control the combined motion of the beam delivery system with respect to distortion of the motifs and positioning tolerances. Herein, the required precision is defined by the visually perceived quality expectation of the customer. The target structuring rate of 400mm/s marks the economic performance requirement for such a 3D system which requires fast and precise control software.

BENEFIT

LAP3D will enable manufacturers to offer individualised marking for large products, even in mass markets. The application to plastic parts in the automotive industry opens a full set of truly innovative aesthetic options which efficiently serve customer demands within an economic budget.
The Maier Group as the user in LAP3D aims at extending current limits in laser-based decoration of large 3d parts. The technology will enable the provision of the same decorative marking on virtually all parts of the car interior and exterior.
In recent times, the decision impact of car aesthetics overrules technical performance and reliability in many cases. A successful implementation of the new technology will provide a significant competitive advantage for the automotive suppliers. Other markets such as furniture and architecture are already prepared to take up similar applications.

ACHIEVEMENTS

First, a control software, suitable for two dimensional problems, was developed. With the new software, the robot can translate the required shape design to 3D. Continuously adjusting the focus position allows for a mark-free motif. We have also developed a software solution that controls the six DOF (degrees of freedom) - system marking on a 2D-surface that involves all drives.In addition to the control software, a quality control system has been developed. Based on machine vision it inspects all the parts after completion. It can detect pattern distortions and displacements, as well as changes in contrast between the pattern and the surrounding area. End-user Maier Group profits from LAP3D's 3D-marking technology by being able to apply it successfully to components for the automotive industry. Innovative computer-based process controlling will allow more flexible and individualized options for marking. Supplier Rofin can improve its product portfolio, thus positioning the company as a leader in the decorative automotive field, accessing train or aircraft manufacturing markets, billboards or panels, furniture etc.

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FEMPAR
LEA 311

Deep engraving system for coining dies withfemtosecond laser

SUP

RTD

USR

CHALLENGE

The assessment aims to provide a robust laser source with improved performances delivering pulse energy of 40 µ Joules at an average power of 40 Watts. New solutions will be implemented to improve the engraving process with respect to speed and quality. Another objective is to remove both “step effect” and “weaving effect”, which come from superposition of slices, but to still provide frosting effects on the surface.

BENEFIT

This innovative laser system will enable Monnaie de Paris (MdP) to produce embossing tools or dies with a better depth resolution compared to the tools used today. The engravers will be able to put sharper details in the design of the numismatic coins. Precise engraving quality is a crucial criterion for the customers of MdP. It also enables important security features, like micro engraving, which cannot be copied by counterfeiters. Moreover, some new surface feature should be obtained with the new system: The “rainbow” effect could be produced and other surface effects will be tested.

Due to the power delivered by the laser the user should be able to reduce the processing time of the dies. The dies’ costs will decrease and the production will be more flexible. The femtosecond lasers have enabled micro-machining of a wide range of materials with great precision.

To address industrial markets, processing time must be as short as possible and reliability in harsh environments is paramount.

ACHIEVEMENTS

FEMPAR delivers the highest power industrial grade laser source with 500 femto seconds pulse duration. It is built on a robust technology platform that enables the delivery of high power and high reliability on a small footprint. The optional second and third harmonic opens additional areas of application that benefit from the new laser source. The FEMPAR result will most probably lead to a new product that can be used in highly demanding 24/7 applications in industry where power, precision and durability are key for the manufacturing success.

NEXTCUT
LEA 312

Multi wavelength diode laser source for cutting applications

SUP

RTD

USR

USR

CHALLENGE

A major goal of the assessment is to combine up to four wavelengths from 808nm to 980nm in one laser system in order to deliver 2kW of continuous power. Furthermore, the diode system solution has to contain integrated beam delivery and beam shaping optics to provide laser radiation through a fibre of 200µm core diameter and numerical aperture of 0.2 which altogether must be suitable for cutting a defined set of metals.

BENEFIT

The successful completion of the NEXTCUT assessment will bring a technologically robust diode solution for cutting of metals to the market. Laser Expertise and EWF as users will have targeted the laser source and its beam delivery and shaping at market requirements by testing it in a production-like environment. After an analysis of the laser material interaction and the cutting quality, final product features will be established including the expected high wall-plug efficiency.

SME end users and other European job-shops will employ the new laser system, which has the advantages of reduced energy consumption and low requirements on floor space and infrastructure. With its flexibility in combining application specific laser power, wavelength spectrum and beam quality, the diode-based laser system can be optimised according to the best performance-cost ratio for the specific user's applications. This will enable flexibility on the shop floor, an increase in services offered to customers and reductions in production time and costs.

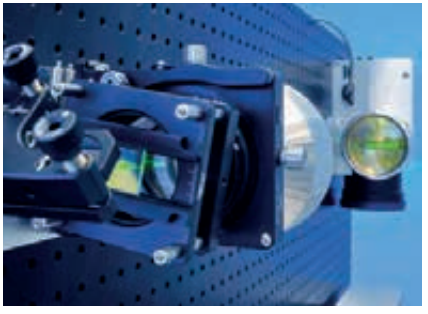
ACHIEVEMENTS

As of yet, the NEXTCUT assessment has succeeded in the stepwise improvement of cut quality for different thicknesses of stainless steel, mild steel, aluminum alloy and nickel 718 alloy. Laser Expertise and EWF as end-users target the laser source and its beam delivery and shaping at market requirements by testing it in a production- like environment. After having analyzed the laser material interaction as well as the cut quality, the expected high wall-plug efficiency can be established. From an economic perspective, end-users Laser Expertise and EWF profit from reduced energy consumption and low requirements on both floor space and infrastructure. The diode-based laser system of NEXTCUT is flexible in combining application- specific laser power, wavelength spectrum and beam quality, and there is still room for even more improvement. By providing flexibility on the shop floor, the customer benefits from an increase in service offered to customers and reduction in production time and costs. With LASHARE and our partners from LIMO, Laser Expertise, EWF and TWI it is possible to apply our research to the current market in the best way possible.

USR = End User
RTD = Research Partner
SUP = Supplier

PARROT
LEA 313

Parallel multi-beam ablation of rotationally symmetric work pieces



SUP HOLO/OR

RTD Fraunhofer ILT

USR BOSCH

CHALLENGE

Industrially robust diffractive optical elements and relay optics are developed to precisely split the laser beam into multiple spots. For constant properties of the processing result, a correct positioning and intensity of each of the spots is vital. With respect to a future product, the solution must allow the supplier to integrate all components into a single mechanical package for a simple transfer to different applications.

BENEFIT

Parallel processing increases the complexity of a production environment but potentially allows a significant cost reduction of the laser-based manufacturing process. A rise of the TRL of equipment for parallel processing will act as an "enabler" for new products which are currently not feasible for reasons of production cost and time. In general, multi-spot laser processing can significantly enhance the productivity and competitiveness of European industry.

This new technology improves the economic feasibility of ultra-short pulsed (USP) laser machining and helps European products to remain or become even more competitive. Applications of USP laser-based single beam processing in mass production are the trimming of sensor elements, the structuring of a drainage groove in diesel injectors and applications in the field of gasoline injection.

The multi-beam technology of PARROT will potentially enable a multitude of next generation products at decreased cost.

ACHIEVEMENTS

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INCLAD
LEA 314

Inside cladding system with integrated process monitoring

SUP

RTD

USR

CHALLENGE

The assessment aims to increase the robustness of the beam guiding system and to protect it against backscattering and powder contamination. One component of the final solution is an imaging system for coaxial remote monitoring of the melt pool. In combination with process map charts, this system will allow the operators and customers to review and qualify the course of the manufacturing process.

BENEFIT

Inside cladding optics use the laser metal deposition process (LMD) to repair or enhance components like oil drilling tools, extruder cylinders and pipelines. The process offers a superior layer quality, accurate geometry and little cost for finishing. Restricted accessibility and high demands on wear and corrosion resistance make inside cladding a challenging technology.

The successful completion of the assessment will enable an easy process set-up despite limited accessibility, monitoring and prevention of deviations from the planned processing. This avoids scrapping of expensive parts such as drilling tools. The market, which can be opened by such a solution, can be estimated through the report of Abakan. They claim annual cost of 2.1 trillion USD for wear and corrosion through early replacement, lost production, poor performance and damage while Applied Market Information estimates the European demand for pipeline coatings to one billion USD. These potentials and economic losses are addressed by the INCLAD solution.

ACHIEVEMENTS

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USR = End User
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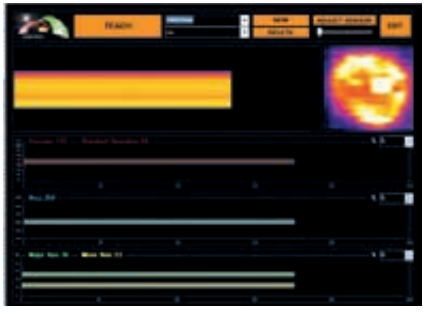
CICERONE
LEA 701

ICT-based quality control setup and operation for laser welding of hydraulic cylinders



SUP CICROSA CILINDROS Y CROMADOS

RTD TECHNOLOGY CENTRE CARTIF

USR EMPIRIC

CHALLENGE

Laser welding inspection systems are frequently used in industrial manufacturing. Most techniques are based on thermal radiation that is emitted during the process. The need for parameterization of these systems to each new welding task causes additional work, often it even leads to an increase in false detections. If it would be possible to make such systems self-learning defects could be detected with only little additional effort. The aim is to create a system with assisted self-learning capabilities to detect close to 100 % of defects and to reduce the false detection rate below 10 %.

BENEFIT

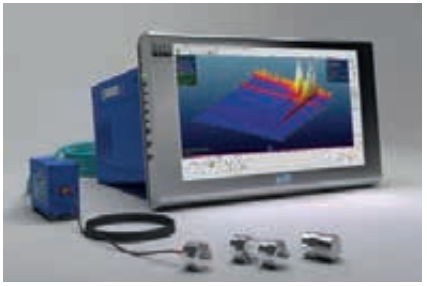
The non-destructive testing system developed in CICERONE is based on laser welding infrared thermography. The system benefits from ICT to enhance its capabilities and to make its use simpler and the use of a tailored camera integration to detect and classify defects originated during laser welding. The system is able to detect lack of fusion, whole penetration, gaps, and porosity by observing how the seams cool down. The CICERONE equipment is able to learn from the human operator to differentiate between faulty and non-faulty welds, and to classify defects according to their class. The CICERONE system will help to reduce scrap rate and speed up production ramp-up time.
Although the equipment has been assessed in the CO2 laser welding of hydraulic cylinders, the equipment is suitable for other laser welding process, laser sources like Nd:YAG or fibre, and other materials different to steel, in particular aluminium.

ACHIEVEMENTS

Equipment for detecting defects in laser welding of steel has been developed accomplishing most goals set. The system features a small camera and easily configurable analysis software implementing a self-learning module. The system can be transferred to several other welding applications with minimum effort.

WEDEBS
LEA 702

Structure borne sound system for laser welding defect detection and correction



SUP

RTD

USR

CHALLENGE

Laser beam welding of critical parts needs process-monitoring and control to ensure 100% quality of the joints. For applications such as the production of pressure sensor glow plugs, joint quality can only be assessed by metallographic analyses which would require the destruction of the part. To ensure constant properties for all parts, the monitoring system needs to identify all process deviations by type and location. As such, the structure borne sound system of the assessment partner QASS needs to be closely integrated with the production equipment and the signal analysis needs to unambiguously map acoustic patterns to events in the welding process. The mastering of this challenge will be validated on real parts at the HIDRIA manufacturing plant.

BENEFIT

Once the structure borne sound detection system of QASS is integrated into the production equipment of HIDRIA, experiments can be conducted to map the acquired signals to welding defects. The development of suitable algorithms will enable to characterize not only the sound sensor and welding defects but also create additional knowledge on how to apply the sensor for the actual manufacturing task. By principle, structure borne sound propagates differently in hard and ductile materials. In combination of the high scanning rate of 100MHz and the capability to process the data online, the WEDEBS system will be capable to detect deviations of the welding process in real-time. This benefits manufacturing quality control and might even enable process control.
Once the WEDEBS system has demonstrated its capabilities, it can be transferred to other laser-based manufacturing processes such as laser cladding or laser cutting.

ACHIEVEMENTS

WEDEBS achieved a new level of quality diagnostics for welding of pressure sensor glow plugs. The laser based welding process is monitored with a new solution that is based on a "Optimiser 4D" system from QASS which has been specifically adapted for the quality monitoring task. Fully integrated in the machine setup, the system monitors structure-borne vibrations and processes these in a dedicated analysis unit. The system is fully synchronised with the numeric control unit to start and stop with the welding process. The analysis system calculates spectrograms from the recorded signals and analyses these for anomalies.
The final prototype is capable of signalling these conditions to adjacent handling systems so that defective welds can be excluded from the propagation through the manufacturing chain.
WEDEBS achieved an integrated quality monitoring system with full control of the products produced. The benefits for the partners drive a new application in manufacturing for the user and a new product for 100% quality monitoring for the supplier.

USR = End User
RTD = Research Partner
SUP = Supplier

ALLEGRO LEA 703

Adaptive plastic laser welding for car door panels

SUP LPKF Laser & Electronics

RTD TECHNOLOGY CENTRE CARTIF

USR GRUPO ANTOLIN INGENIERIA

CHALLENGE

The interior trims in the Automotive Industry are becoming more complex every day, integrating new functionalities, customization, etc., with an important impact in the manufacturing processes demanding more flexibility, quality improvement and low cost. Laser welding technology could be a feasible, cost effective and reliable alternative to the current ultrasonic welding technologies, with more flexible and reusable machines, that allow an optimization in the product design and better quality control. This was the challenge of the Allegro LEA, try to validate the laser welding technology for car interior door panels, developing and validating at the same time the necessary materials, equipment's, processes and quality controls.

BENEFIT

The current ultrasonic welding technology requires a high amount of investments for every project, where dedicated or almost dedicated machines are needed for each door panel. Furthermore, later modifications in this machines are quite complicated and expensive. The development of the laser welding technology for door panels could be an option to get more flexible, affordable and reusable welding equipment, making possible to share machines for different models, to reuse the machines in future projects, and also easing the setup and the later modifications. On the other hand, in the Allegro assessment, the partners have strived in the development of a closed loop quality control, based in the integration of a pyrometer. This could be a feasible solution to implement defect detection and auto setup system in the machines, leading to a quality improvement. Once the project finishes, the developed technologies might be ported or adapted for other market areas such as batteries for Electrical Vehicles, white goods, etc.

ACHIEVEMENTS

Laser based plastic welding has been successfully assessed with car interior door panels. Both linear and wobbling welding technologies fulfilled the aesthetical and mechanical customer requirements. Different materials and thicknesses were tested and validated. The defect detection was limited by the pyrometer configuration, nevertheless, promising results were reached.

PROCUT3D
LEA 704

3D variable depth laser cutting system for production of rubber profiles

SUP

RTD

USR

CHALLENGE

Sealing of car doors are complex in shape, need to be long term reliable and cheap. Besides, they need to fulfil an ever growing set of functions from water protection, wind protection, and resistance to sun's UV light degradation, to name only some properties. Most rubber based seals contain an metal core which provides a completely different set of mechanical properties. Cutting of these sealing structures therefore is a complex task. PROCUT3D aims to create a laser-based manufacturing tool that can easily adapt processing strategy and processing parameters to the current type of sealing profile. Different layers of metal, rubber and air need to be taken into account to provide a burr free and non-carbonized cut face of the sealing. All this needs to be executed in three dimensional space along a predefined trajectory which needs to be matched to the actual position of the profile.

BENEFIT

In contrast to the traditional die-cutting machines, the PROCUT3D laser-based cutting machine will be flexible in setup and programming to enable a fast transition from processing one type of sealing to another. Through a close integration of design files and machine control, the configuration effort for the operator will be at a minimum. The process parameters will be adapted depending on the current type of profile such that the power of the laser is controlled to cut the different layers.

The programming of the cutting trajectory will be implemented through an ICT interface such that reprogramming is simple. The achievement of these goals will deliver a flexible machine that can produce car sealing on demand and reduce energy and time consuming production steps.

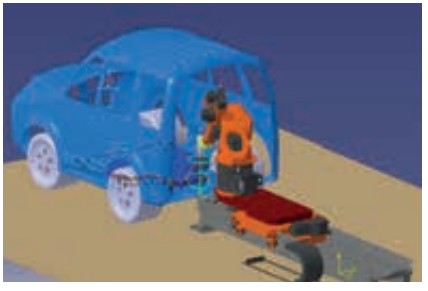
ACHIEVEMENTS

Laser based car door seals cutting has been satisfactorily assessed in a purpose-developed robotized fibre laser cutting cell. Some issues due to soot formation were found to be solved to a large extent using short pulse lasers. An acceptable method for 3D cutting trajectories generation based on commercial software was established.

USR = End User
RTD = Research Partner
SUP = Supplier

SCALP LEA 705

3D laser scanning and laser cutting system for the production of vehicles for disabled drivers



SUP FARO

RTD ALPhA NOV Centre Technologique Optique et Lasers

USR A.C.A adaptation automobile

CHALLENGE

Disabled people depend on suitable and reliable vehicles which also need to fulfil all automotive and regulatory standards but the market is so small that car manufacturers cannot serve it with individualized solutions as each car is a one-off. For companies such as the French ACA, modification of series cars is the only way to provide mobility to such people. It involves dismantling of the car body and manual operation to cut the floor and to introduce new structures and devices. A laser based equipment that enables scanning and cutting would reduce the physically demanding cutting and the time consuming manual planning of the modification. For scanning and data processing, surface reflectivity and complex shape needs to be taken into account and for cutting, the three dimensional trajectory and different types of materials need to be taken into account. A significant advance in this production environment also requires a smooth integration of both solutions to bring the full benefit.

BENEFIT

Automated scanning of the car structure would remove the requirement for time consuming measurements as construction data files normally are not shared by the manufacturers. The automated transfer to an ICT solution that creates the path planning will help to derive suitable process parameters for the laser cutting process such that the cut can be executed with minimal burr and high success probability. With a direct transfer of this data to a cutting robot, an error free positioning of the cut would ensure minimal re-work on the car body. This would also reduce the need for re-painting and mechanical intervention and relieve workers from physically demanding cutting tasks. Overall, the closely integrated acquisition of geometry data, the planning of the cutting trajectory and the automated processing of the car body will reduce the overall time for this manufacturing step noticeably so that the cost for such car modification can be reduced significantly.

ACHIEVEMENTS

LEA705 SCALP achieved its goals to demonstrate an automatic solution for 3D data acquisition from a high-speed scanner and its use for laser cutting with a 6-axis robotic arm on a real car. The overall processing time (3D modeling + cutting of the rear floor) of SCALP solution takes 2h with an accuracy of ±1mm instead of 8-10h for the manual current process without 3D CAD file.

LASAO
LEA 706

Adaptive optics for improved femto second laser beam quality and stability

SUP imagine optic

RTD ALPhA NOV Centre Technologique Optique et Lasers

USR ARGOLIGHT A PRECISION COMPANY

CHALLENGE

Fluorescence imaging systems have become ubiquitous equipment in life sciences, clinical diagnosis, forensic, etc. Despite impressive technological advances, quantitative measurements from fluorescence imaging systems remain difficult to obtain, as the performances of these devices tend to fluctuate over time. ARGOLIGHT uses an exclusive patented technology to induce fluorescent features using lasers inside innovative glasses, both in 2D and 3D that are perfectly suited to assess and monitor the performances of such devices. The patterns can reproduce cell-like features in terms of size and fluorescence intensity, but perfectly known and stable. LASAO aims to validate a closed loop control wave-front correction system from IMAGINE OPTIC for the optimization and long-term stabilization of laser beam parameters during the engraving of fluorescent patterns inside glass from ARGOLIGHT. The objectives are threefold: (i) increasing the laser wave-front stability by at least 20 %; (ii) improving the laser beam quality to produce new, more complex patterns in 3D; and (iii) producing thinner engraved patterns, below 1 µm (currently 4 µm).

BENEFIT

The LASAO system will provide the technology for a new level of beam shape stability and aberration correction. For laser-based micro-processing, it opens a market where precision in final shape is a key at a level that was unachievable before. The more repeatable and more precise manufacturing process would enable better quality control tools for fluorescence imaging systems, which would support scientific research all over the world. The solution will also be applicable to the fabrication of optical memories, prototyping of integrated optical circuits, laser-fabricated phase masks and in-vivo customization of intra-ocular implants.

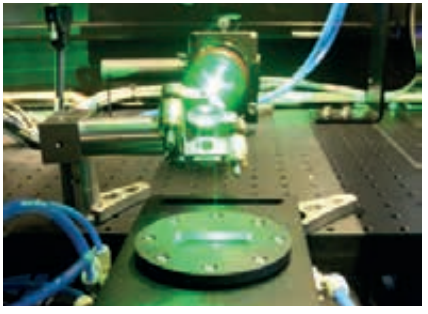
ACHIEVEMENTS

We demonstrated that adaptive optics could be used as a tool for high precision ultrafast laser intra-volume engraving of transparent materials. The LASAO system allows to control the length of laser interaction volume in glass. In particular we almost reached the theoretical diffraction-limited length, with a reduction of the modification length by 55 %.

USR = End User
RTD = Research Partner
SUP = Supplier

PAPS
LEA 707

Automated positioning, alignment and process setup for laser welding of microfluidic chips



SUP lasing

RTD aimen TECHNOLOGY CENTRE

USR SensLab An EKF Diagnostics Company

CHALLENGE

Sealing of complex microfluidic labs-on-chip arrangements is key for its functionality, the price for the sealing is key for its market penetration. Manufacturing of polymer lab-on-chip devices actually relies on adhesive bonding which is little flexible and costly. Accuracy specifications move towards 50 µm total error over distances that exceed 50 mm which cannot be achieved in laser-based welding today because of the multi part alignment of polymer carrier and sealing foils. Throughput is limited by time-consuming and costly alignment operations, difficulties for automation, and defective parts. Typical defects are failure in seam position, inclusions, pores and very often variable seam quality in intricate curvilinear welds.

BENEFIT

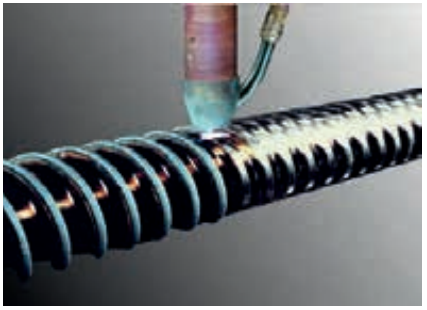
PAPS aims at a laser-based equipment that integrates loading, handling, alignment welding and final inspection in one go. The integration of all these steps ensures that parts are placed to specification and that in the case of detected errors, the part can be correctively processed. The digital integration of all information at ICT level ensures fast setup for new products, reliable selection of processing parameters and continuous documentation of the production process which is key in medical applications. The final inspection ensures that the part is released with an individual quality documentation and thus eases the traceability of the product. Once the PAPS system is fully validated, the transfer to other segments such as thin polymer film applications in electronics will be exploited.

ACHIEVEMENTS

A working prototype of a laser welding system has been produced in PAPS, demonstrating its operation by laser sealing a real microfluidic device by SENSLAB. Overall accuracy with PAPS laser process has been verified to be better than 10µm. It ensures great repeatability, producing high quality welding seams as thin as 60 µm, while providing a very high productivity rate: under 5 seconds are required to weld a whole complex microfluidic chip, granting plenty of time for the handling and inspection processes.

MALCES
LEA 708

Machine tool for automated laser cladding of extruder screws



SUP

RTD

USR

CHALLENGE

Extruder screws are needed in the food industry as well as in manufacturing where viscous material needs to be transported through pipes. Sizes of such screws range from a few centimetres to metres in diameter while the complex 3D shape is common to all of them. This shape is what makes extruder screws difficult to create and expensive. The functionality of such a screw however is defined by its extrusion efficiency which diminishes over time through wear on the outside. Refurbishing of such screws preserves the material and energy resources that went into their creation but it is difficult to efficiently reach the required geometry. After a grind-down step, the actual geometry needs to be measured to feed the required build up to a laser-based metal deposition system. If this was integrated in one ICT based data processing and robot-based execution system, then repair would become possible on the fly.

BENEFIT

The MALCES system aims to apply a geometry scanning system for acquisition of actual construction data as an input to the path planning system. Therein, an automated parameter selection will provide the needed parameters to create a processing path which in turn is transferred to the robot for laser-based cladding of metal. The integration of all these systems will bring an increase in efficiency and a reduction in the need for manual intervention. The key advantage however is, that through the integration into one machine, the processing can be adapted to actual build up rate. Therefore, the MALCES system might be one of the first systems that implement a near-net shape repair of extruder screws.

ACHIEVEMENTS

MALCES achieved a huge step forward in "digitising" the Laser Metal Deposition process (LMD). Aiming at repair processes, the precise scanning of the work piece was implemented trough a cost efficient laser line scanner. This enables the acquisition of data of the worn geometry towards an actual CAD-Model of the workpiece. Based on this Digital Twin, NC-Tracks are calculated to the LMD process. The target of the process enhancement for the LMD process its self was set to double the processing speed for an economic viability of the overall solution.
The validation in a production-like scenario proved an increase from 18 mm/min for of the PTA process to 45 mm/min with the MALCES process. The impact of automated work piece scanning and process improvement thus is fourfold.

USR = End User
RTD = Research Partner
SUP = Supplier

FAST3DSA
LEA 709

Fast 3D scanning solution for advanced material processing

SUP SCANLAB innovators for industry

RTD LZH LASER ZENTRUM HANNOVER e.V.

USR SITEC

CHALLENGE

Surface modification and micromachining today move from the processing of flat surfaces to markets where three dimensional shapes are requested. As for this kind of laser-based manufacturing the processing beam needs to be scanned over the work piece with speed of up to 10 meters per second, highly dynamic scanning devices are an essential must. While there are plenty of good implementations for scanning in the plane, the solutions for a displacement of the beam in the third dimension lags behind by a factor of four. A new approach to extend a 2d scan system - with a third axis to scan the third dimension with the same proven and highly dynamic galvo technology as the first two axes - has been demonstrated at lab scale and now needs to be applied in industrial manufacturing.

BENEFIT

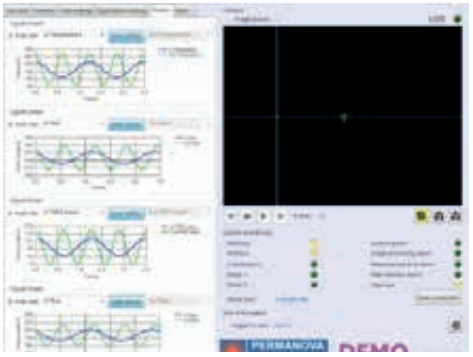
FAST3DSA aims at the application of a new scanning system manufacturing systems with a focus on surface modification and micromachining of industrial products. The additional dimension adds the possibility to enter new markets where parts with three dimensional functional surfaces would be enhanced by laser-based manufacturing processes. The assessment will validate the viability of established 2d processes into the third dimension and provide a basis to exploit increasingly powerful ultrafast laser sources towards industrial applications.

ACHIEVEMENTS

The new dynamic z-axis, adapted to a standard 2D scanning system, enables highly dynamic laser processing of complex 3D surfaces. Compared to conventional z-axes, several tests have shown that the new z-axis is not a limiting factor any more thanks to the use of galvanometer technology. The new system enables identically high acceleration values in all three spatial directions.

INNOSEAM
LEA 710

Multisensor system for adaptive control of laser welding



SUP

RTD

USR

CHALLENGE

Use of nickel and titanium parts for civil aircrafts drives the demand for laser-based welding because of the connected boost in productivity and quality of the final part. The low heat that laser welding introduces into the welded material makes it a prime choice in manufacturing. However, the laser welding process has stricter requirements for material preparation and fit-up of the abutting sheets and plates as a result of material vaporisation, fast welding speeds and, subsequently, a highly dynamic process. Process monitoring systems commonly use a seam tracker to detect geometrical mismatch and a vision systems for detecting surface defects in the melt pool. These sensor systems have concrete limits. Close or too distant butting edges often do not produce sufficient signals to detect the seam or lots of light during the welding process disturbs the image captured by camera and affects overall performance of the monitoring capability. A missing integration of seam tracker signals and vision/infrared camera images most often lead to an incomplete or a misaligned picture of the weld.

BENEFIT

If the INNOSEAM assessment manages to provide a viable solution to the challenge, then laser-based welding of structural components from nickel and titanium will receive an improved joint integrity and better fatigue performance. The adaptive control system will combine the information from the seam tracking device and the signals from the laser fibre and evaluate them in real-time. Based on the validation runs, a database will be established that maps the signal events to welding defects for later analysis and algorithm development. Once validated, the INNOSEAM can be transferred to other application areas where the detection of process deviations in welding support the overall manufacturing outcome.

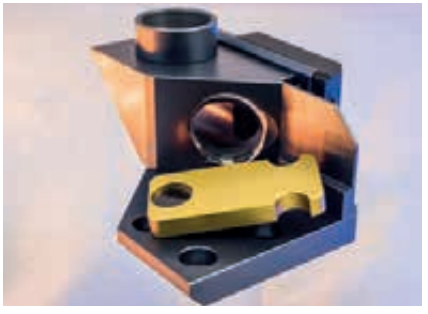
ACHIEVEMENTS

The latest seam tracking hardware and software developed by the INNOSEAM project, and shortly available commercially from Permanova, not only offers through-optics camera tracking of joints during welding, the equipment can also be tailored to log and flag warnings to the operator when weld quality deviates outside customer-defined acceptance limits. With a reliable quality monitoring system then in place the need for post-weld inspections can be reduced. This can be achieved without resorting to bulky equipment off-axis, as joint illumination built in to the coaxial nozzle, a compact seam tracking camera and integrated photodiodes work together to collect, present and analyse welding process monitoring data in real time. There is no need for any additional equipment, with the INNOSEAM system therefore representing a cost-effective improvement for in-process monitoring of key parameters.

USR = End User
RTD = Research Partner
SUP = Supplier

INSPECT
LEA 711

Integrative sensor grid for quality monitoring of micro manufacturing processes



SUP PULSAR PHOTONICS

RTD Fraunhofer ILT

USR VECO precision metal

CHALLENGE

Micro material processing creates structures and properties which mostly cannot be inspected without additional optical instruments. In many cases, this prevents quality control during manufacture as microscopes are needed to analyse the process result. Such high resolution microscopes cannot be embedded into manufacturing systems for technological and mainly economic reasons. What can be done is the determination of the machine status to adjust setting parameters as an adoption to changed boundary conditions. INSPECT aims to develop an integrated sensor grid for micro machining of filters which is able to monitor laser characteristics, machine conditions and deduce a statement about the process result.

BENEFIT

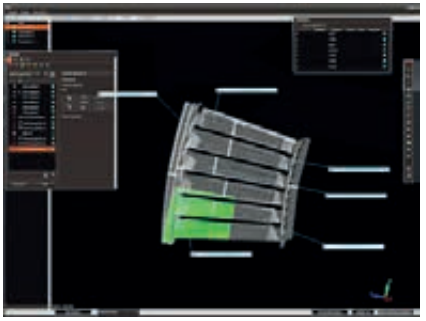
The filtration market as a multibillion dollar market needs new technologies to produce finder filters at affordable prices. Since there exists an increasing demand from emerging countries industry needs to respond with increasing level of automation in the near future. Machines that can adapt their setting parameters based on the determination of boundary conditions may perform at a much more constant level. This enables the production of new filters with enhanced technological features to remove unwanted content and for example make water clean water. The integration of a multitude of sensors to a grid that extracts information about the machine conditions and an ICT based proposition on how to adapt accordingly to meet the required product quality may be seen as a template to other machines and industries. Unlike electroforming, which is the most commonly used method for the production of metal sieves, laser drilling completely avoids the production of chemical waste.

ACHIEVEMENTS

The Inspect sensor grid showed that with the use of the collected data the manufacturer is able to detect deviations from the stable process and relate those to changes in the state of the machine itself, the laser source or even external factors. With the sensor grid users will not only gain a better understanding of the laser process they are using but also of the laser processing machines own life. Analyzing the collected data furthermore helps to identify critical process parameters and environmental influesces, improve process parameters and reduces the time needed to setup a new process. In combination with the data from the process monitoring module product quality can validated directly in the production machine.

PROPER
LEA 712

3D digital tool chain for additive part repair



SUP DATAPIXEL

RTD aimen TECHNOLOGY CENTRE

USR Láser

CHALLENGE

Repair of worn metal parts is mostly done by SMEs which do have special knowledge about the requirements of their market segment. In most cases, deviations in geometry account for the need to repair a part, be it due to wear and abrasion or due to mechanical loads that lead to distortion of the part. Each of these cases though starts with the requirement to acquire the actual geometry of the part. Once the additive process is started, it is key to add only the amount of material that is needed to avoid additional post processing activities. The time and skills required to account for distortions and geometric factor impact strongly on overall running costs, and hinder the wide adoption of laser cladding as an efficient repair technology by SMEs.

BENEFIT

This assessment aims to reduce costs, time, and resources on the one hand and retain full dimensional quality control on the other hand by enhancing laser cladding. PROPER makes use of a control system based on 3D-monitoring and point-cloud processing, hence minimizing the set-up time to result in fast and flexible repair process. Achievements in enhanced robot vision will be applicable to a wider range of laser cladding applications in different markets, for example high value parts in power generation or mining. PROPER assessment wants to create a solution for SMEs that is affordable and allows them to retrofit their equipment.

ACHIEVEMENTS

An integrated adaptive repair solution by laser cladding was developed and validated at end user facilities that repairs real 3D complex worn tooling components and high value parts. It embraces segmentation and point cloud software algorithms that allow simple selection of areas where surface functionalisation will be applied. The automatic layer cladding path planning includes laser cladding parametrization towards a full processing program for repair and surface functionalisation.

Highlights of the developments comprises a RT geometry measurement system based on 3D machine vision technology. With the help of triangulation principles, this system enabled a direct transfer of the point cloud into the robot coordinate system. The algorithms for matching the measurements to the real world included a fast disparity determination to facilitate precise repair operations. In combination with an on-line path planning system an automatic adaptation of cladding tracks was achieved with a direct integration into a ROS based system that is independent of the robot brand.

USR = End User
RTD = Research Partner
SUP = Supplier

ACTFAST
LEA 713

Real-time laser process monitoring system with fibre integrated sensors

SUP OPTOSKAND

RTD TWI

USR SODECIA

CHALLENGE

Detection of events during laser material processing is done with sensors from lateral and coaxial perspectives. Making use of the fibre that delivers the processing laser beam however is new. In laboratory tests the detection of back radiation through the processing fibre has been demonstrated in some applications. A robust detection of quality relevant features in an industrial environment still needs to be developed taking into account all environmental influences that can occur. While the advanced technology has improved productivity, the remaining problem is to detect weld defects quickly, reliably and cost-effectively in on line mode because post process detection accounts for scrap and economic losses.

BENEFIT

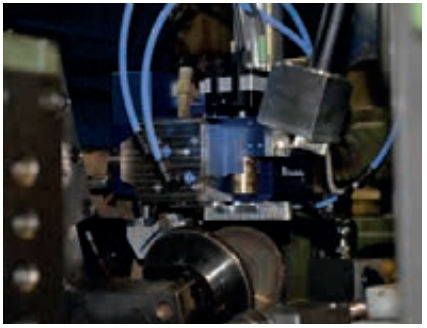
The successful implementation of suitable sensors and detection algorithms will deliver data that can be used for process analysis. The identification of robust correlations between signals and welding defects then sets up an ICT based decision system to either adapt processing parameters or to stop the manufacturing task for manual re-inspection. Once accepted by the assessment partners, the validation phase of the assessment can demonstrate the possibility of reducing or even eliminating post welding quality checks.

ACHIEVEMENTS

The ACTFAST system has demonstrated its capability to monitor and detect changes in laser welding power, and also the surface cleanliness of the components to be welded can be detected. The goal of the project was to improve the quality assurance of Sodecia's automotive shift fork components that form part of the dual clutch transmission assembly. These components are manufactured in a hot-rolled, high strength low-alloy steel and all welds are partially penetrating butt welds. The main defects seen in these welds are lack of penetration defects as well as accuracy of the weld placement on the joint line.
The outcome of the project has been a successful step forward in reducing the part scrappage rate by providing indication via FFBD and visible light signals whether a weld process could be successful, and therefore the laser process can be inspected and corrected.

SPOTNSEAM
LEA 714

Closed-loop control system for continuous laser spot on seam



SUP

RTD

USR

CHALLENGE

There is a growing demand from customers requiring tubing or profile products from different materials, diameters and/or wall thicknesses. European tube/pipe manufacturers need to improve overall efficiency of their production and introduce new manufacturing techniques to reduce production costs and to enhance reliability of their products for mission critical or safety related tubing. Critical criteria for this product quality is a continuously precise guidance of both sides of the tubing or profile material to ensure constant process boundary conditions. Simple laser triangulation methods do not suit the requirements as in some processes the material is fed with zero distance between the joint pairs.

BENEFIT

The implementation of a multi sensor monitoring system for seam tracking will increase robustness in seam detection including adaptive filtering and control. Based on high speed image processing, the ICT solution will embed processing power to enable the generation of control signals in real-time. The interfacing with the environment will be so transparent and independent of machine type that not even the assessment partners' diverse manufacturing machines benefit from an easy installation approach but also others.

The transfer of the system to other setups is supported by modal interfaces that enable the control of any actuator for re-adjustment of laser and seam at affordable investment.

ACHIEVEMENTS

A novel seam tracking system for monitoring and control has been developed. An integrated welding head was designed in several engineering steps. The design considered crucial factors like adaption to production line with optical elements for higher power, field of view, focal length, spacing to forming rolls and access of media. For the control of the peripheral system components a real time PLC is used. The tracing of the integrated welding head is carried out by a servomotor installed crosswise to feeding direction. A high-speed camera with embedded FPGA and GigE Vision serves as image acquisition device. Furthermore, the software development and the implementation of algorithms were carried out. The complete set of functions is implemented as hardware operators and guarantees image processing in real-time. The system is able to detect the position and orientation of the seam and tool center point simultaneously. This is a significant advantage since the system can accommodate shift in laser spot position.

USR = End User
RTD = Research Partner
SUP = Supplier

WP300

RESEARCH PARTNERS

USERS AND SUPPLIER

WP700

RESEARCH PARTNERS

USERS AND SUPPLIER

MANAGEMENT PARTNERS

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