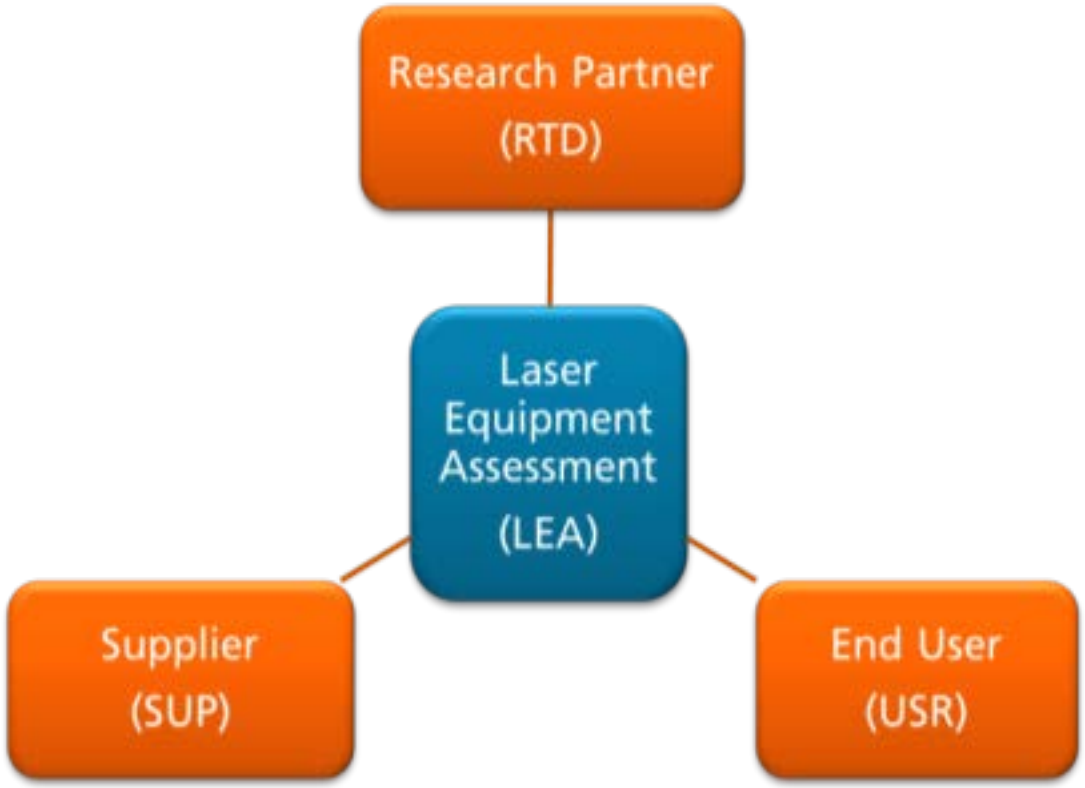
# LASHARE – Innovation for manufacturing SME's through Laser-based Equipment Assessment


This project has received funding from the European Union's Seventh Framework Programme
for research, technological development and demonstration under grant agreement no 609046

# LASHARE – Vision and Overview

## Roles in Laser-based Equipment Assessments (LEAs)

- Supplier (SUP)
  - SME company providing a laser based equipment
- End User (USR)
  - Industrial company using laser- based equipment for manufacturing
- Research Partner (RTD)
  - Research institution providing scientific support for development of laser-based equipment

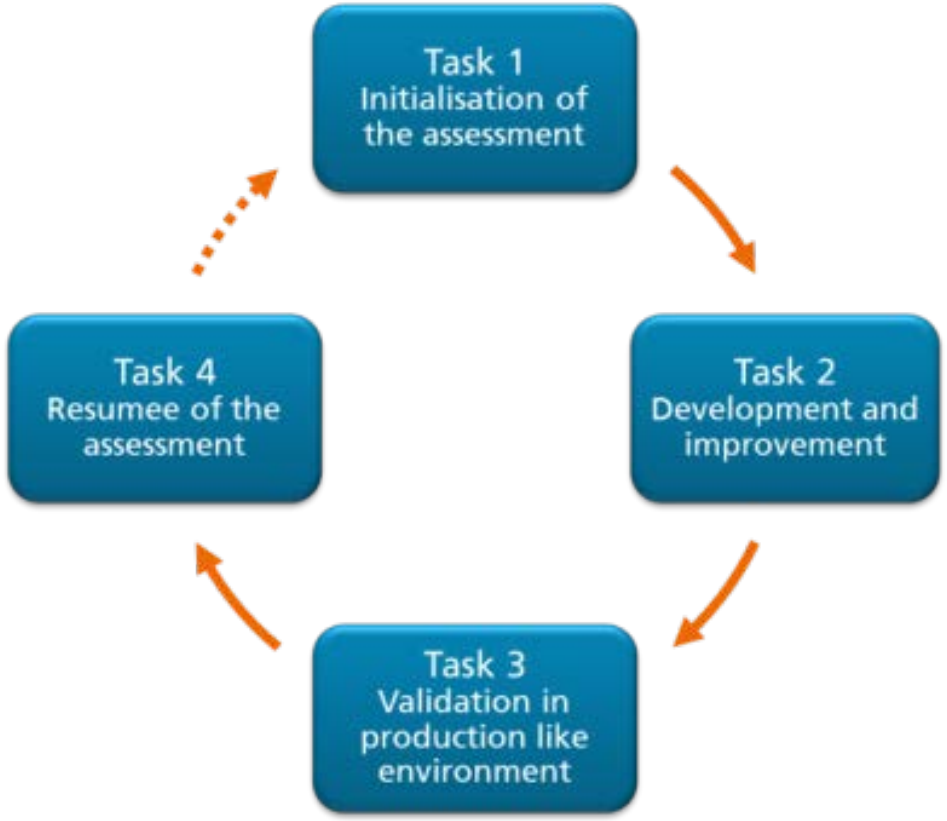





This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE – Vision and Overview
## Phases of the Assessment Circle

- Task 1 – Initialisation
  - Defintion of demand and objectives
  - Development plan
- Task 2 – Development and Improvement
  - Implementation
- Task 3 – Validation
  - Evaluation of objectives in a production like environment
- Task 4 – Resumee
  - Evaluation of achievements and feedback to the methodology



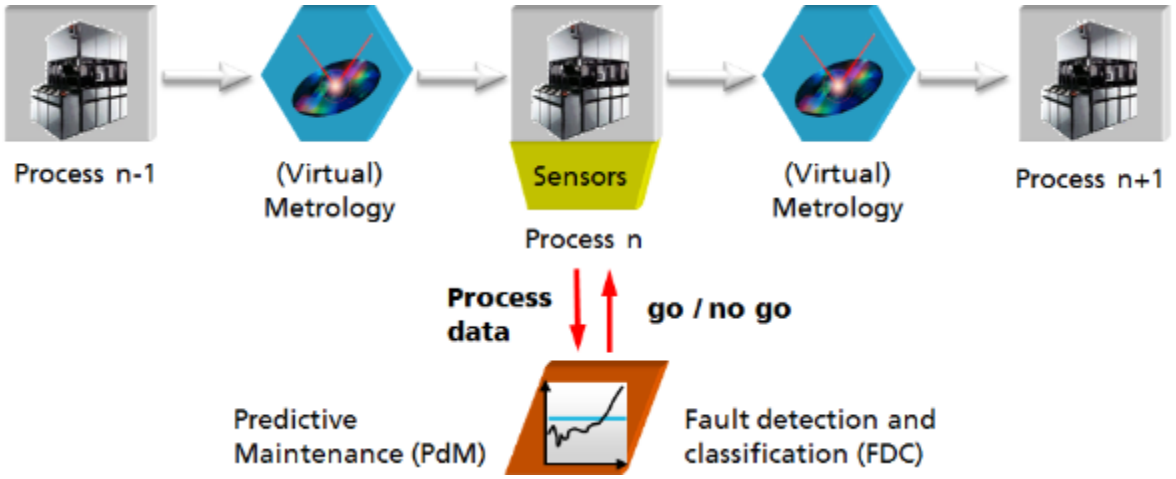



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP200 – Cross Sectional Activities

Data-driven production optimization

- Generic approaches for common application scenarios:
  - Automated reporting, fault detection/classification/prediction
  - Equipment health monitoring, predictive maintenance
  - Virtual metrology
- Prototype implementation of a data-driven optimization scenario




Application scenario for predictive maintenance, fault detection and classification, and virtual metrology



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE – Consortium

## Partners of WP3xx at a glance




LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE
## Laser-based Equipment Assessments (LEA)

- Phase 1: 2013-2016
- Phase 2: 2016-2018



This project has received funding from the European Union's Seventh Framework Programme
for research, technological development and demonstration under grant agreement no 609046

# LASHARE
## Laser-based Equipment Assessments (LEA)

| Acronym | LEA | Title |
|---|---|---|
| ALPS | 301 | Vision based laser cutting for patterned fabrics |
| FLAT | 302 | Plug in laser diode module for warm sheet metal forming |
| LASPRO | 303 | Laser beam profiler for online characterization of spot properties |
| TEETO | 304 | Compact sub nanosecond laser source for thin film processing |
| FCPS | 305 | Laser system for flexible CIGS photovoltaic scribing |
| CUDE | 306 | Direct diode laser system for cutting of mild and stainless steel |
| MOBILLAS | 307 | Mobile laser system for on site material processing |
| TWOMICRO | 308 | Two micron laser source for light weight materials and medical sector |
| HELIDRILL | 309 | Helical laser drilling system for micro vents and conducts |
| LAP3D | 310 | Laser processing system for stitching structured patterns on large 3D parts |
| FEMPAR | 311 | Deep engraving system for coining dies with femtosecond laser |
| NEXTCUT | 312 | Multi wavelength diode laser source for cutting applications |
| PARROT | 313 | Parallel multi beam ablation of rotationally symmetric work pieces |
| INCLAD | 314 | Inside cladding system with integrated process monitoring |



This project has received funding from the European Union's Seventh Framework Programme
for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP301 – APLS
## Laser-based Equipment Assessment (LEA)

ALPS - Vision based laser cutting for patterned fabrics

- Develop fixing system for laser cutting of light deformable fabrics adaptive to different materials with inhomogeneous properties
- Invent a model based vision system for fast pattern learning to locate and cut with sub-mm accuracy without prior marking on fabric
- Increase cutting performance and overall throughput for all relevant batch sizes

Manual and automated cutting

Motivs to be detected and cut

**Supplier**

SIMAUPRO

**User**

Selmark lingerie

**Research Partner**

aimen CENTRO TECNOLÓGICO



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP302 – FLAT
## Laser-based Equipment Assessment (LEA)

FLAT – Plug in laser diode module for warm sheet metal forming

- Integrate a vibration resistant laser diode module directly into a sheet forming machine
- Deliver up to 1kW@1cm² using direct regular water cooling for operation from 10 to 40ºC
- Reduce forces in roll forming by 50%
- Implement a totally spring-back-free process with 100% geometric certainty after forming

Laser diode stack

Roll forming machine

**Supplier** monocrom

**User** Johnson Controls

**Research Partner** aimen CENTRO TECNOLÓGICO



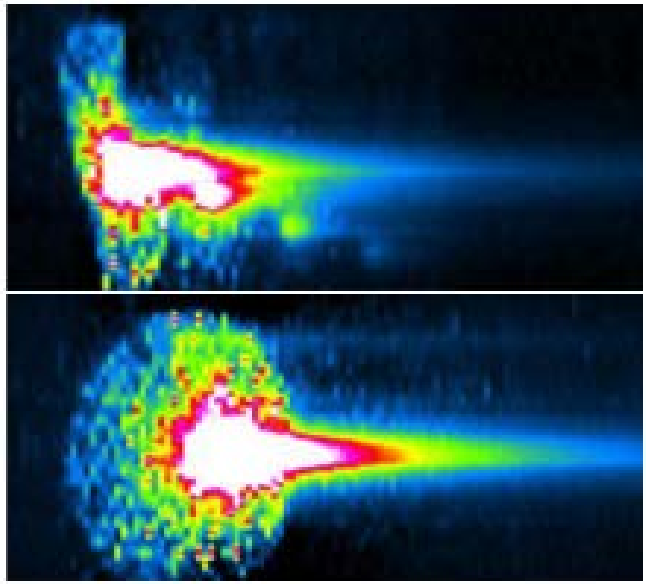
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP303 – LASPRO
## Laser-based Equipment Assessment (LEA)

LAPSRO - Laser beam profiler for online characterization of spot properties

- Monitor the IR emission of the weld pool with a repetition rate of 10 kHz
- Provide a tool for online detection of process instabilities in laser beam welding
- Enable closed loop control of the laser welding process



Defocused (above) / Focused (below) laser beam images obtained with a low cost uncooled 32x32 IR array manufactured by NIT

**Supplier** NIT New Infrared Technologies

**User** FIAT CRF CENTRO RICERCHE FIAT

**Research Partner** aimen CENTRO TECNOLÓGICO



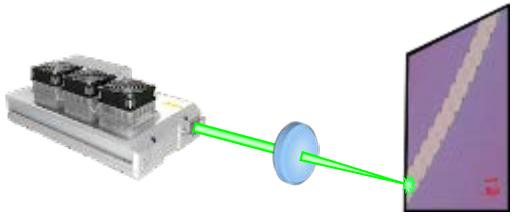
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP304 – TEETO
## Laser-based Equipment Assessment (LEA)

TEETO - Compact sub nanosecond laser source for thin film processing

- Provide a price competetive long term stable laser source
- Enhance productivity by an increase of 30% in average power
- Implement a top hat energy distribution for thin film processing



Laser source for thin film processing
With top hat energy distribution

**Supplier**

**User**

**Research Partner**



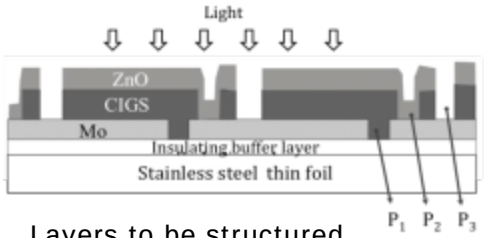
This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP305 – FCPS
## Laser-based Equipment Assessment (LEA)

FCPS - Laser system for flexible CIGS photovoltaic scribing

- Provide a process for the scribing (P1) of the molybdenum layer, without changing the underlying insulating layer
- Enable structuring of CIGS (P2), parallel to (P1), without affecting the molybdenum layer, allow parallel removal of TCO (P3) without sacrificing other layers
- The three scribing are characterized by an amplitude <50µm and 2m/s processing speed

Manufacturing system for CIGS scribing




Layers to be structured in three different steps

**Supplier** **User** **Research Partner**



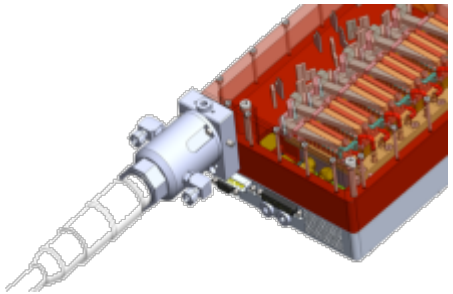
This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP306 – CUDE

## Laser-based Equipment Assessment (LEA)

CUDE - Direct diode laser system for cutting of mild and stainless steel

- Pump a 9xx nm diode laser system to robustly deliver 1kW at 7.5 mm*mrad
- Provide optical and electrical interfacing for industrial application in the area of cutting
- Demonstrate diode laser cutting of mild steel up to 6 mm, stainless steel up to 4 mm, and aluminium up to 3 mm



Diode laser module from prototype to rack version

**Supplier**

directphotonics

**User**

Prima Power

**Research Partner**

LZH
LASER ZENTRUM HANNOVER e.V.



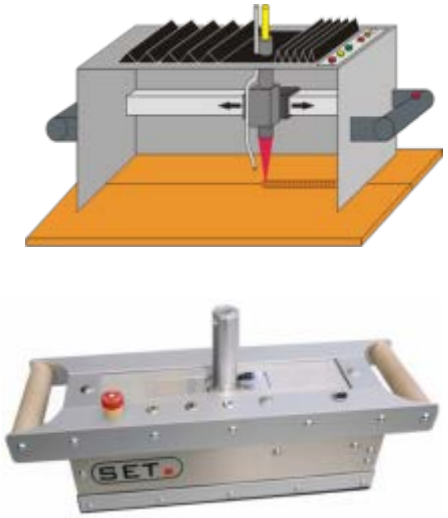
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP307 – MOBILLAS
## Laser-based Equipment Assessment (LEA)

MOBILLAS - Mobile laser system for on site material processing

- Provide a fully integrated and portable laser system for on site cutting and welding
- Allow mobile and safe operation in the field such as in ship yards
- Develop a system with minimal training requirements applicable to large structure manufacturing with thick materials




Application and principle of multi beam processing

**Supplier**

SET

**User**

ALS MARINE CONSULTANTS LTD

**Research Partner**

LZH
LASER ZENTRUM HANNOVER e.V.



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP308 – TWOMICRO
## Laser-based Equipment Assessment (LEA)

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

- Provide a 2 micron laser source with power and beam profile stability
- Feed 200 Watts of stable power into a 125µm fibre
- Demonstrate reproducibility of scribed grooves and other processes with the new laser source


Laser processing systems

**Supplier**

PRIMES

LISA LASER PRODUCTS THE 2micron COMPANY

**User**

trotec laser. marking cutting engraving

**Research Partner**

LZH LASER ZENTRUM HANNOVER e.V.



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP309 – HELIDRILL
## Laser-based Equipment Assessment (LEA)

HELIDRILL - Helical laser drilling system for micro vents and conducts

- Build a high performance control system with automatic beam calibration for different hole geometries
- Support interfacing to diverse shop floor environments with control protocols and standard laser coupling
- Provide easy to use user interface (UI) with process monitoring capabilities for reliable processing

Model of the integrated drilling optics

**Supplier**

S&F Systemtechnik GmbH

**User**

P&G
BRAUN
Oral-B

**Research Partner**

Fraunhofer ILT



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP310 – LAP3D

## Laser-based Equipment Assessment (LEA)

LAP3D - Laser processing system for stitching structured patterns on large 3D parts

- Develop a system to process 3D workpiece with a large working area
- Implement a machanooptical solution to allow surface curvatures of up to 270º reducing distortion
- Realise a structuring rate of 400mm/s for a 3D system based on an improved and precise control software using inputs from different CAD sources.

Sample dash board application

**Supplier**

rofin
ROFIN-BAASEL ESPAÑA

**User**

MAIER

**Research Partner**

Centro tecnológico CARTIF

Fraunhofer ILT



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP311 – FEMPAR
## Laser-based Equipment Assessment (LEA)

FEMPAR - Deep engraving system for coining dies with femtosecond laser

- Provide a robust laser source with improved performances 40µJ 50W
- Develop solutions to improve the engraving process speed and quality
- Remove the “step effect” from superposition of slices and the “weaving effect”
- Obtain frosting effects on the surface


Laser source and coining die

**Supplier**

Amplitude SYSTEMES

**User**

MONNAIE DE PARIS

**Research Partner**

ALPhA NOV
Centre Technologique Optique et Lasers



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP312 – NEXTCUT
## Laser-based Equipment Assessment (LEA)

NEXTCUT - Multi wavelength diode laser source for cutting applications

- Combine up to four wavelengths from 808nm to 980nm in one laser system to deliver 2kW of continuous power
- Develop a suitable integrated beam delivery and beam shaping optics with a fibre of 200µm core diameter and NA of 0,2
- Provide a diode laser solution with 20mm mrad suitable for cutting

Image courtesy of LIMO

Rack with the laser source and complementary systems

**Supplier** LIMO Lissotschenko Mikrooptik

**User** EWF; LASER EXPERTISE

**Research Partner** TWI



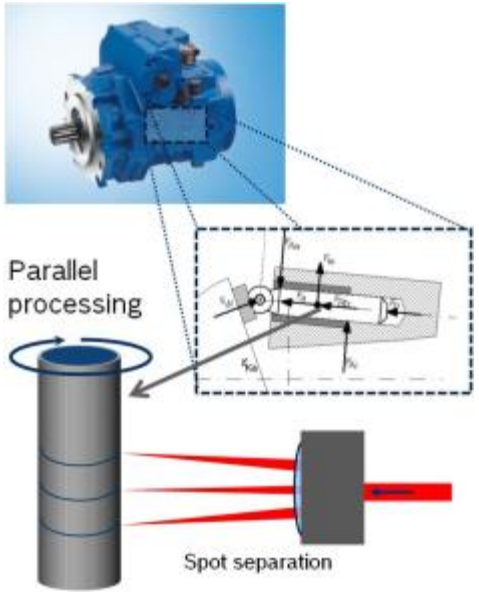
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP313 – PARROT
## Laser-based Equipment Assessment (LEA)

PARROT - Parallel multi-beam ablation of rotationally symmetric work pieces

- Modify the surface microstructure to achieve new properties
- Develop industrially robust diffractive optical elements and optics to split the laser beam into multiple spots
- Increase manufacturing efficiency by parallel processing




Application and principle of multi beam processing

**Supplier** HOLO/OR

**User** BOSCH

**Research Partner** Fraunhofer ILT



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP314 – INCLAD
## Laser-based Equipment Assessment (LEA)

INCLAD - Inside cladding system with integrated process monitoring

- Increase robustness of the beam guiding system against backscattering and powder contamination
- Implement an imaging system for coaxial remote monitoring of the melt pool
- Develop process charts to enable reviewing the course of the manufacturing process

Images of the IPO optics for cladding

**Supplier**

IPG LASERTECHNIK GMBH

**User**

SULZER

Sulzer Metco

**Research Partner**

Fraunhofer ILT



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE – Consortium

## Partners of WP7xx at a glance




LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE – Vision and Overview
## Laser-based Equipment Assessmets (LEAs)

| ACRONYM | LEA | TITLE |
|---|---|---|
| CICERONE | 701 | ICT-based quality control setup and operation for laser welding of hydraulic cylinders |
| WEDEBS | 702 | Structure borne sound system for laser welding defect detection and correction |
| ALLEGRO | 703 | Adaptive plastic laser welding for autonomous production of car door panels |
| PROCUT3D | 704 | 3D variable depth laser cutting system for production of rubber profiles |
| SCALP | 705 | 3D laser scanning and laser cutting system for the production of vehicles for disabled driver |
| LASAO | 706 | Adaptive optics for improved femto second laser beam quality and stability |
| PAPS | 707 | Automated positioning, alignment and process setup for laser welding of microfluidic chips |
| MALCES | 708 | Machine tool for automated laser cladding of extruder screws |
| FAST3DSA | 709 | Fast 3D scanning solution for advanced material processing |
| INNOSEAM | 710 | Multisensor system for adaptive control of laser welding |
| INSPECT | 711 | Integrative sensor grid for quality monitoring of micro manufacturing processes |
| PROPER | 712 | 3D digital tool chain for additive part repair |
| ACTFAST | 713 | Real-time laser process monitoring system with fibre integrated sensors |
| SPOTNSEAM | 714 | Closed-loop control system for continuous laser spot on seam |

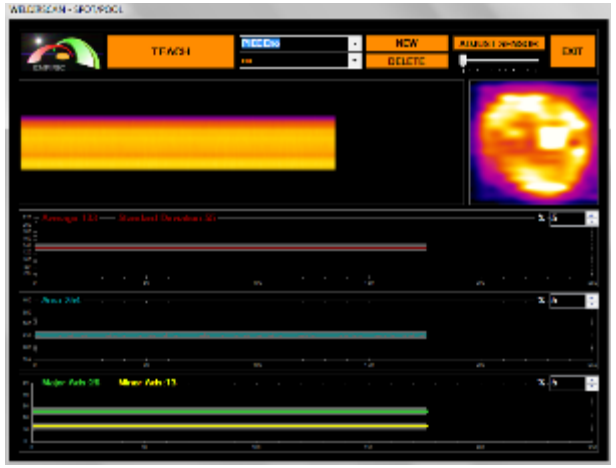


This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP701 – CICERONE
## Laser-based Equipment Assessment (LEA)

CICERONE - ICT-based quality control setup and operation for laser welding

- Quality control system for laser welding based on infrared capable cameras
- Features learning ICT based capabilities that make system parameterisation extremely easy
- Laser welding of hydraulic cylinders for testing




Inspection software front end during teaching phase

**Supplier**

EMPIRIC

**User**

CILINDROS Y CROMADOS

**Research Partner**

[TECHNOLOGY CENTRE] CARTIF



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP702 – WEDEBS
## Laser-based Equipment Assessment (LEA)

WEDEBS Detection of welding defects by structure bourne sound

- Reliable qualification of laser welding
  - Adaptation of sensors for easy application
  - Classification of acoustic patterns for various laser welding defects
  - Development of automation strategies for defect detection and failure handling

Structure borne sound analyser

**Supplier** QASS

**User** Hidria

**Research Partner** LZH LASER ZENTRUM HANNOVER e.V.



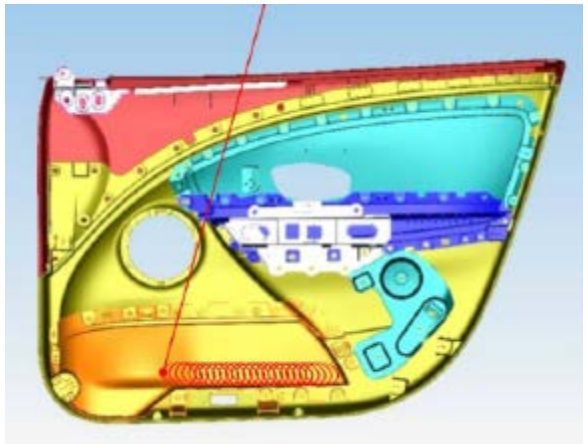
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP703 – ALLEGRO
## Laser-based Equipment Assessment (LEA)

ALLEGRO - Adaptive plastic laser welding for car door panels

- Pyrometer based quality control with closed-loop controller.
- Autonomous set-up for the laser and the clamping system
- Assess capabilities in an operational environment (TRL7) – car doors manufacturing.



Laser welding of door panels

**Supplier**

LPKF Laser & Electronics

**User**

GRUPO ANTOLIN INGENIERIA

**Research Partner**

TECHNOLOGY CENTRE CARTIF



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP704 – PROCUT3D

## Laser-based Equipment Assessment (LEA)

PROCUT3D - Rubber profiles cutting along variable-depth three dimensional path

- Control cut depth for variable profile structures
- Develop process to cut rubber-aluminium profiles without burning rubber parts
- Automatic programming of cutting trajectories using profile cross-section definition and cut specifications
- Control a three-dimensional positioning system to fulfil the specified precisions in trajectory tracking.

**Supplier**

**User**

**Research Partner**



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP705 – SCALP
## Laser-based Equipment Assessment (LEA)

SCALP – 3D scanner used for automated steel sheet laser cutting in the production of vehicles for disabled drivers

- Evaluate a 3D scanner to obtain real 3D CAD file of the car
- Assess the possibility to integrate such scanner on a 6-axis robotic arm
- Evaluate the performance in terms of laser processing 2D/3D car parts


*Credit : PRECITEC*

**Supplier** FARO

**User** A.C.A adaptation automobile

**Research Partner** ALPhA NOV Centre Technologique Optique et Lasers



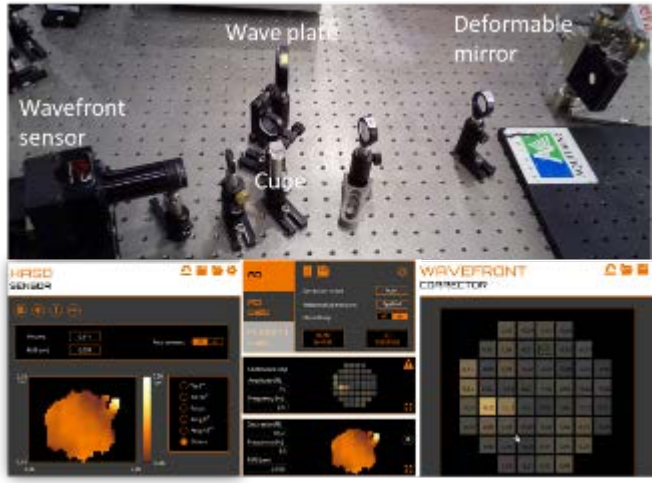
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP706 – LASAO
## Laser-based Equipment Assessment (LEA)

LASAO – Use of adaptive optics to improve quality & stability of femtosecond laser beam

- Improve the achieved homogeneity of the current pattern designs by 20 %
- Increase the available processing time by 100% for more complex patterns
- Reduce engraved line widths from 250nm to 200 nm




**Supplier**

imagine optic

**User**

ARGOLIGHT

**Research Partner**

ALPhA NOV
Optics & Lasers Technology Center



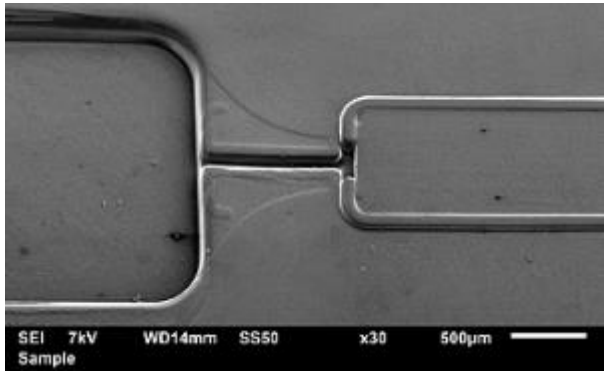
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP707 – PAPS
## Laser-based Equipment Assessment (LEA)

PAPS - Automated Positioning, Alignment and Process Setup for Laser Welding of Microfluidic Chips

- Automated solution for laser seal welding of microfluidic polymer films, including: handling, alignment and positioning.
- Fully Automate handling, positioning and alignment, using Machine vision and embedded intelligence.
- Provide 100% reliability with Short cycle times.




Detail of Embossed Microfluidic Channel

**Supplier** lasing, s.a.

**User** SensLab — An EKF Diagnostics Company

**Research Partner** aimen

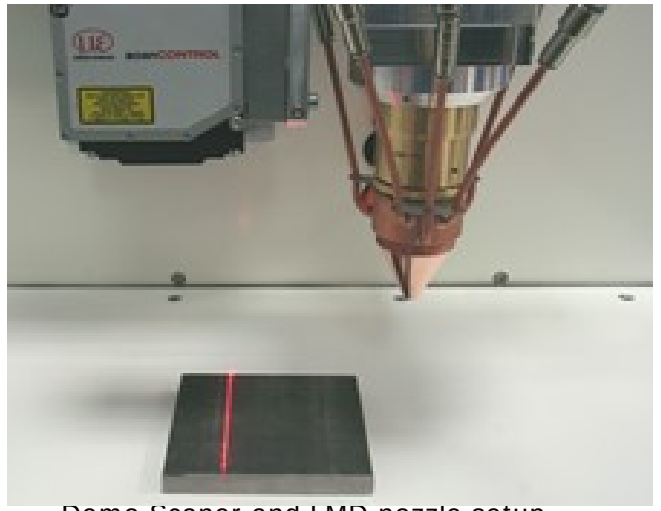


This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP708 – MALCES
# Laser-based Equipment Assessment (LEA)

MALCES – Machine Tool for automated laser cladding of extruder screws

- Installation of a closed loop scanning system
- Development of Laser cladding [LMD] Process adapted to the repair case
- Implematation of a automated laser based repair process



Demo Scaner and LMD nozzle setup

**Supplier**

LUNOVU Integrated Laser Solutions

**User**

arenz Plastifizier-und Verschleiß-Technik

**Research Partner**

Fraunhofer ILT



LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP709 – FAST3DSA
## Laser-based Equipment Assessment (LEA)

FAST3DSA – Material processing by fast 3D Scanning solution

- Performance in a machine environment has to be validated.
  - Dynamics & Precision in 3D laser micromachining applications
  - Robustness: long-term stability, acceleration, high laser power
  - Operation with ultrashort pulsed lasers (scale up in power?)
  - Integration: hw/sw interfaces for easy machine integration
- An optimized product configuration for the USR's application has to be found and tested.
  - high speed and large 3D working volume (for a fast process)
  - constant focus quality over 3D working volume at all speeds (for a stable process)

**Supplier** SCANLAB innovators for industry

**User** SITEC

**Research Partner** LZH LASER ZENTRUM HANNOVER e.V.

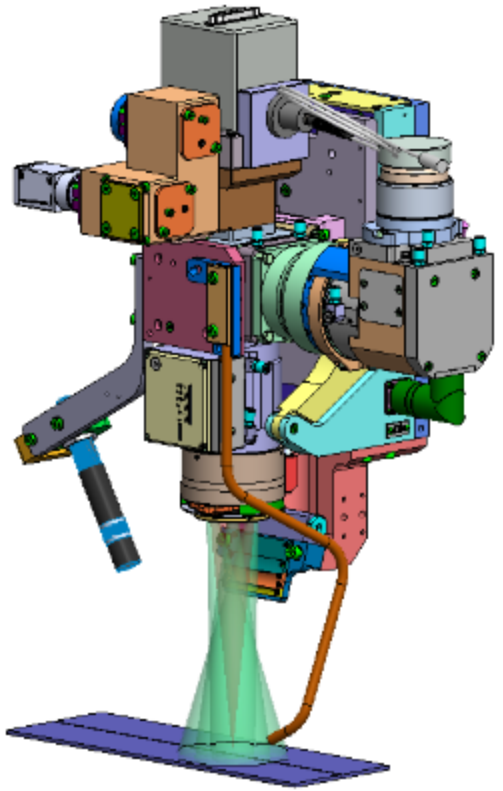


LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP710 – INNOSEAM

## Laser-based Equipment Assessment (LEA)



INNOSEAM – Innovative

- The project objectives are to develop and validate an innovative laser welding adaptive control system, by:
  - Integrating processing monitoring signals from an existing state-of-the-art fibre-optic cable into a seam tracking system
  - Relating monitoring signals to equipment and/or process changes
  - Providing capability of adapting laser welding process to maintain weld quality and reduce NDT burden

**Supplier**

PERMANOVA Lasersystem ab

**User**

GKN AEROSPACE

**Research Partner**

TWI

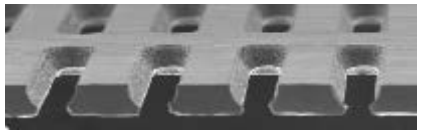
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP711 – INSPECT
## Laser-based Equipment Assessment (LEA)

INSPECT - Integrative sensor grid to monitor micro manufacturing process

- Adaption of sensor modules to optical scanning system and manufacturing challenges
- Development of methods and algorithms for quality related data processing and reduction
- Implementation data fusion procedures and visualization for reporting and system maintenance



**Supplier**

PULSAR PHOTONICS

**User**

vecoy

**Research Partner**

Fraunhofer ILT



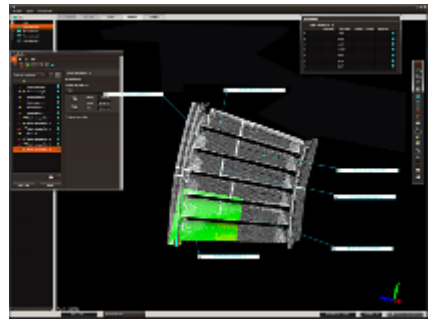
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP712 – PROPER
## Laser-based Equipment Assessment (LEA)

PROPER – Part repair with optimised processing

- Demonstrate an integrated, RT adaptive system for laser cladding of complex structures, based on 3D machine vision.
- Define the specifications of complex repair operations, with reduced robot programming and process adjustment.
- Deliver an interoperable system, based on ROS-Industrial, and demonstrate its performance in relevant applications.



**Supplier**

DATAPIXEL

**User**

GNC Láser

**Research Partner**

aimen CENTRO TECNOLÓGICO



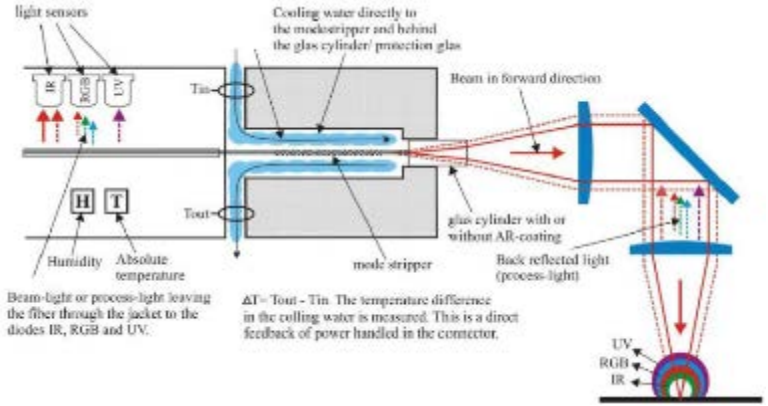
LASHARE

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP713 – ACTFAST
## Laser-based Equipment Assessment (LEA)

ActFast – real-time process monitoring for active welding assessment

- Develop Real-time process monitoring using active sensors integrated inside an optical fibre for high power laser welding of automtive components
- Detailed specifications of the laser applications being welded by Sodecia
- Installing and testing of the fibre at TWI; perform matrices of experimental trials.
- Validation in the production environment




The working principle of the active sensors inside a fibre-optic cable

**Supplier**

OPTOSKAND
OPTIMIZE YOUR LASER

**User**

SODECIA
ADDING VALUE TO OUR CUSTOMERS

**Research Partner**

TWI

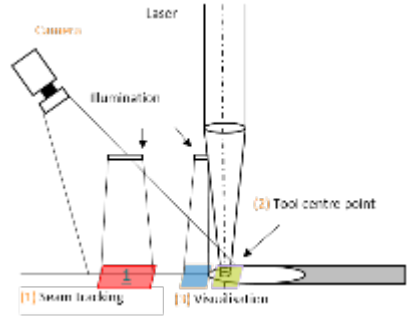
LASHARE

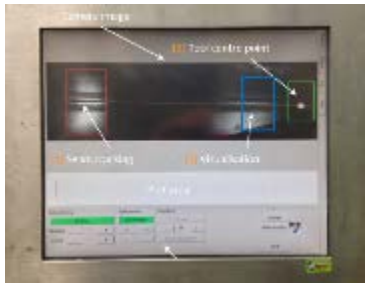
This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046

# LASHARE WP714 SPOTnSEAM
## Laser-based Equipment Assessment (LEA)

SPOTnSEAM- System for closed-loop control of laser spot position on seam

- Design and manufacture of an integrated welding head
- Extend seam position detection by triangulation and adaptive filtering and control
- Improvement of user interface's usability, error tolerance, configurability



Seam tracking system: components and touch-panel with user interface

**Supplier**

LASERFACT Strahlwerkzeuge

**User**

welser profile

**Research Partner**

Fraunhofer ILT



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 609046