



Laser welding in shipbuilding industry – Contributions from joint R&D projects

Dr. Markus Kogel-Hollacher
R&D Projects
14.12.2020



**EPIC Online Technology Meeting on Industrial Laser
Manufacturing for Naval and Aeronautic Applications**

NUMBERS & FACTS

PRECITEC IS AN INTERNATIONAL OPERATING COMPANY GROUP

- Headquarters **Gaggenau** and **Neu-Isenburg**, Germany
- Employees **610** worldwide
 - 315** in Gaggenau
 - 150** in China
 - 95** in Neu-Isenburg
- Turnover 2018 **160 million €**
- Growth **10-20%** per year
- **Innovation and market leader** in the core areas of laser material processing and optical measurement
- Independent **family-owned enterprise**
- **High investment** in Research & Development

Gaggenau

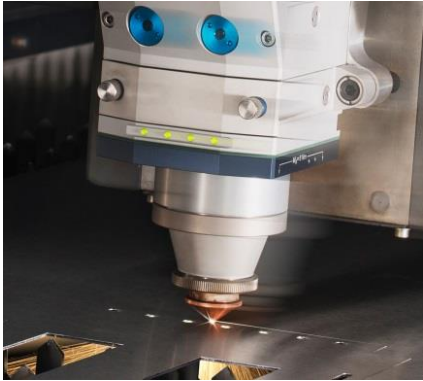


Neu-Isenburg



FIVE DIVISIONS

LASER CUTTING



- Processing heads for laser cutting on flatbed, tube and robot machines
- Processing heads for fine, bevel and high speed cutting
- Process monitoring

JOINING TECHNOLOGY



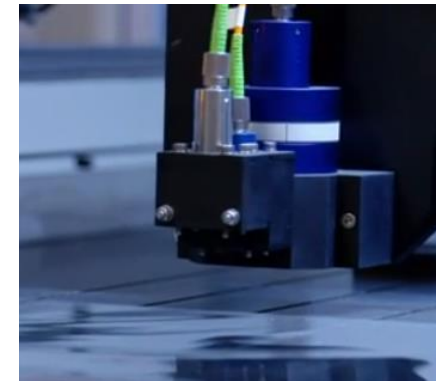
- Processing heads for laser welding and laser cladding
- Monitoring systems for pre, in and post processing

ALL-IN-LIGHT



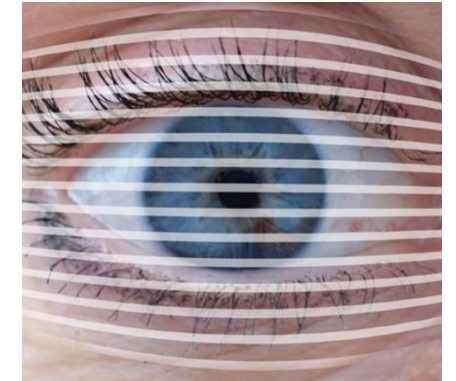
- Complete optical solution from one supplier
- Including laser beam source, cutting head and beam guidance

MEASUREMENT



- Chromatic confocal sensors
- Interferometric sensors
- 2D Vision Camera
- Point, Line and Multipoint and Scanning

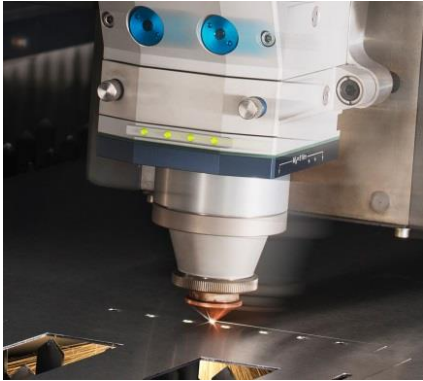
MEDICAL TECHNOLOGY



- Control for corneal and refractive surgery
- Eye tracking systems

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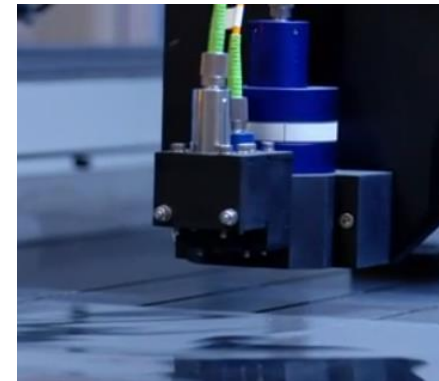
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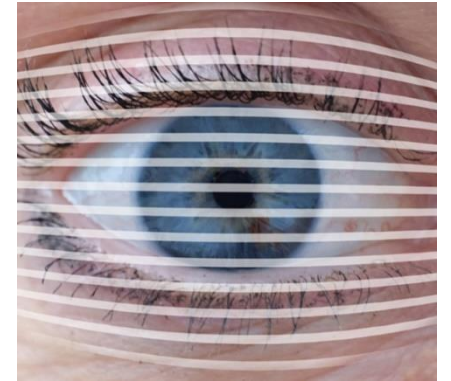
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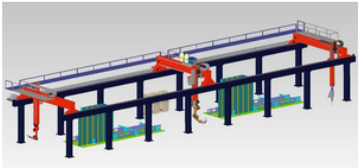


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Visit: www.precitec.com

THIS PRESENTATION SHOWS EXCERPTS FROM

QulnLas



High-quality 3D Laser welding of innovative ship constructions

The objective of the project QulnLas is to develop adequate process-, system- and valuation methods for laser-supported joining processes such as MIG/MAG Laser Hybrid or Laser Remote process which are able to meet the future demands on three-dimensional welding constructions in the ship-building industry. Core of the project is a laser-support system solution in order to facilitate the ship design, accelerate the production and increase the quality. Other industries, such as the automotive and the mechanical engineering industries, also benefit from this development.

Project Partners:

- TUHH iLAS, Hamburg
- Fraunhofer ILT, Aachen
- Fraunhofer IZFP, Saarbrücken
- TUHH SKF, Hamburg
- Fraunhofer LBF, Darmstadt
- Meyer Werft, Papenburg
- Blohm und Voss, Hamburg
- CLOOS, Haiger
- Germanischer Lloyd, Hamburg
- IPG Laser, Burbach
- Precitec, Gaggenau

LASAAS –

"LASERSTRAHLSCHWEISSEN VON STAHL UND ALUMINIUM FÜR DIE ANWENDUNG IM SCHIFFBAU"

FÖRDERKENNZEICHEN 03SX386A-F

DR.-ING. STEFAN KAIERLE	Laser Zentrum Hannover e. V.
DIPL.-ING. RABI LAHDO	Laser Zentrum Hannover e. V.
DR.-ING. RAINER WAGENER	Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit LBF(Darmstadt)
DIPL.-ING. BENJAMIN MÖLLER	Fraunhofer-Institut für Betriebsfestigkeit und Systemzuverlässigkeit LBF(Darmstadt)
DR.-ING. OLIVER MEIER	LASER on demand GmbH (Burgdorf)
DR.-ING. FLORIAN ALBERT	Scansonic MI GmbH (Berlin)
DR.-ING. MARKUS KOGEL-HOLLACHER	Precitec GmbH & Co. KG (Gaggenau)

SHIPLIGHT –

NACHHALTIGER SCHIFFSLEICHTBAU DURCH EFFIZIENTES UND FLEXIBEL AUTOMATISIERTES 3D-LASER-LICHTBOGEN-HYBRIDSCHWEISSEN

FÖRDERKENNZEICHEN 03SX389A-H, J-K

C. EMMELMANN	IAPT
O. STEINMEIER	Fraunhofer-Einrichtung für Additive Produktionstechnologien
G. CERWENKA	IAPT
M. MÖLLER	Meyer Werft
F. BOEKHOFF, M. DRÖSSER	Fr. Lürssen Werft
B. URBAN	Fraunhofer-Institut für Lasertechnik ILT
W. FIEDLER, F. SCHULZE	LASER on demand
O. MEIER, J. LINDNER	Precitec GmbH & Co. KG
M. KOGEL- HOLLACHER	

HYBRILAS

Schweißen von Dickblech mit brillanten Laserstrahlquellen

Projektpartner:

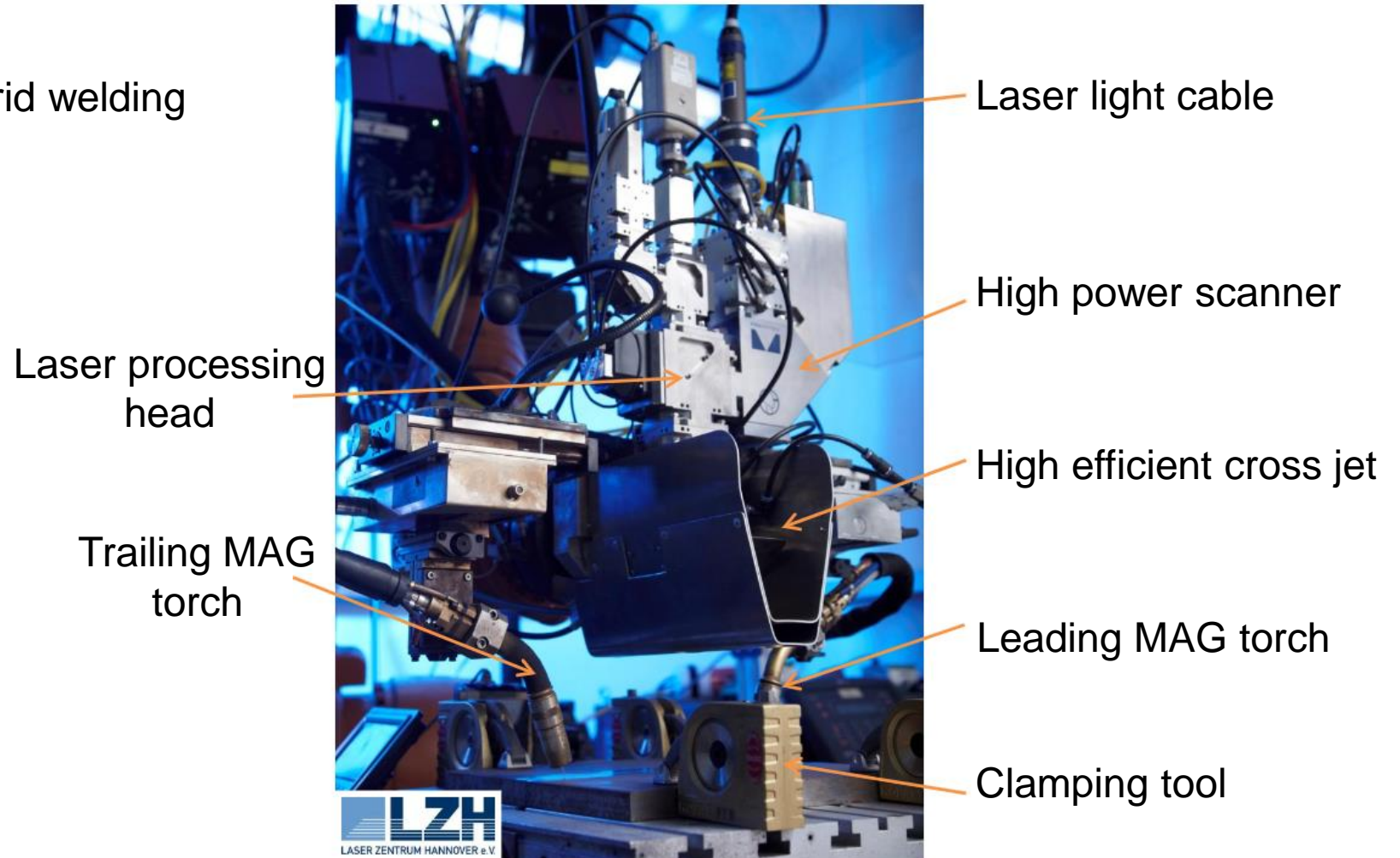
*EWM Hightec Welding GmbH
Laser Zentrum Hannover e.V.
Messer Group GmbH
Nordic Yards Warnemünde GmbH
Precitec KG
Salzgitter Mannesmann Forschung GmbH
SIAG Tube & Tower GmbH
SLV Halle*

LASER AND ARC

THICK SECTIONS NEED LASER HYBRID WELDING SOLUTIONS

Advantages of MIG / MAG laser hybrid welding compared to SAW welding

- No or less edge preparation
- One-sided and single-layer
- Lower thermal load
- Higher welding speed with greater welding depth

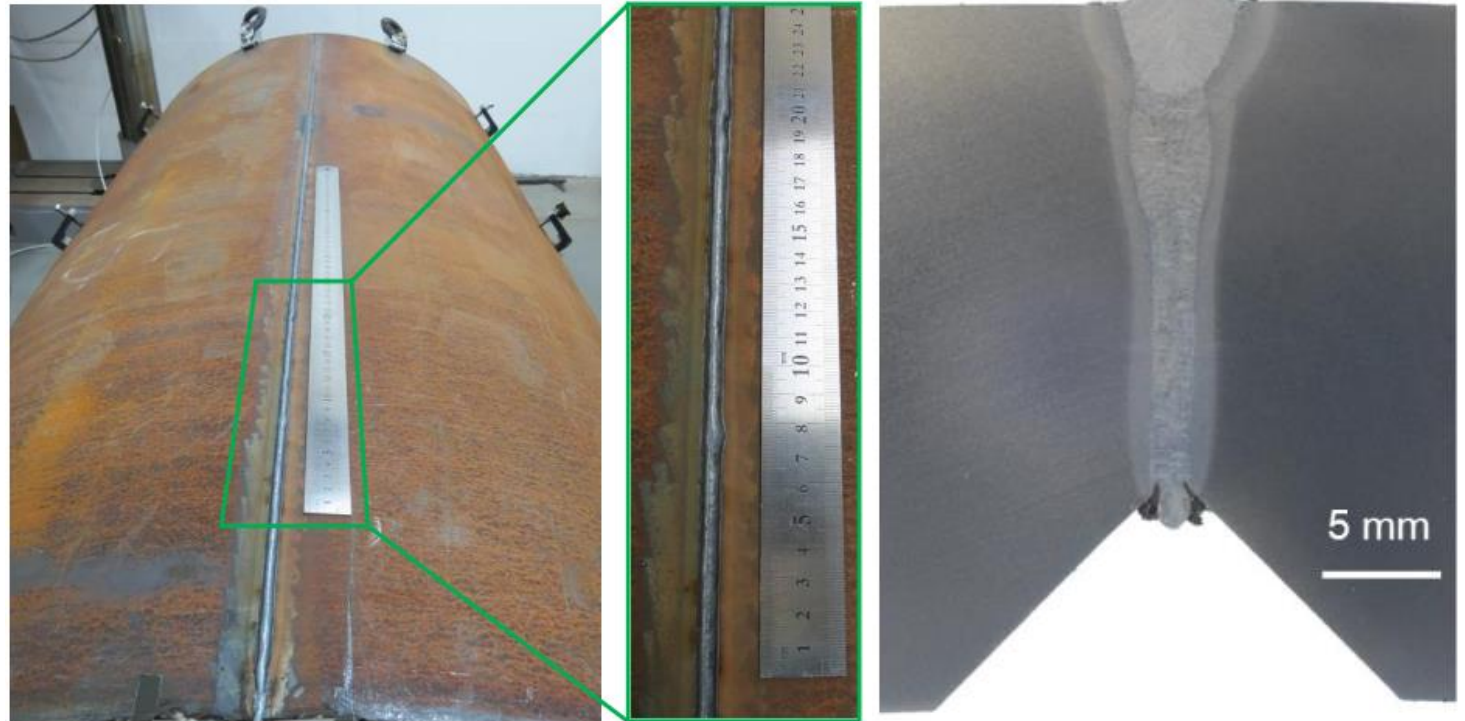


LASER AND ARC

THICK SECTIONS NEED LASER HYBRID WELDING SOLUTIONS

Process parameters:

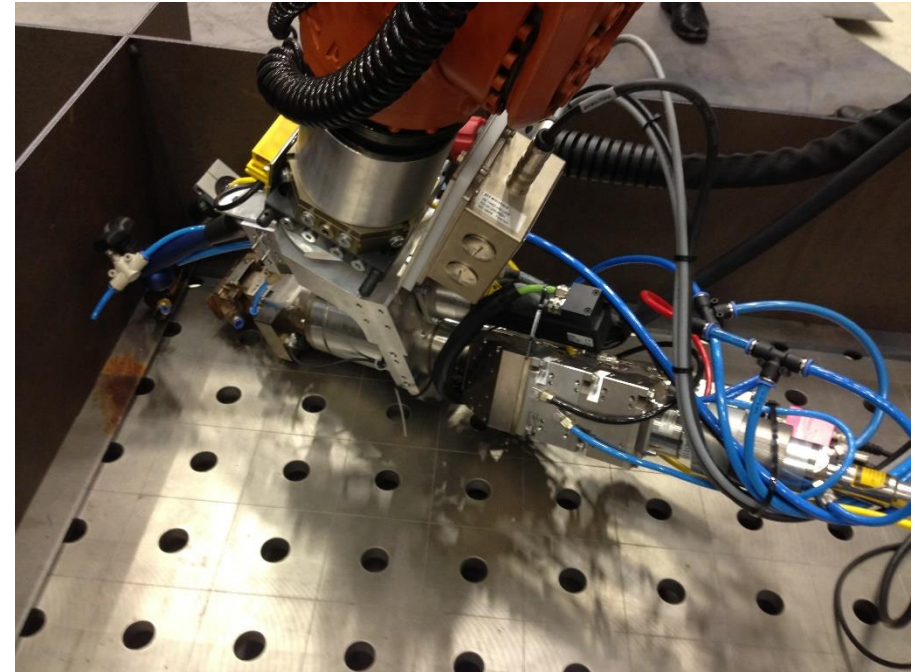
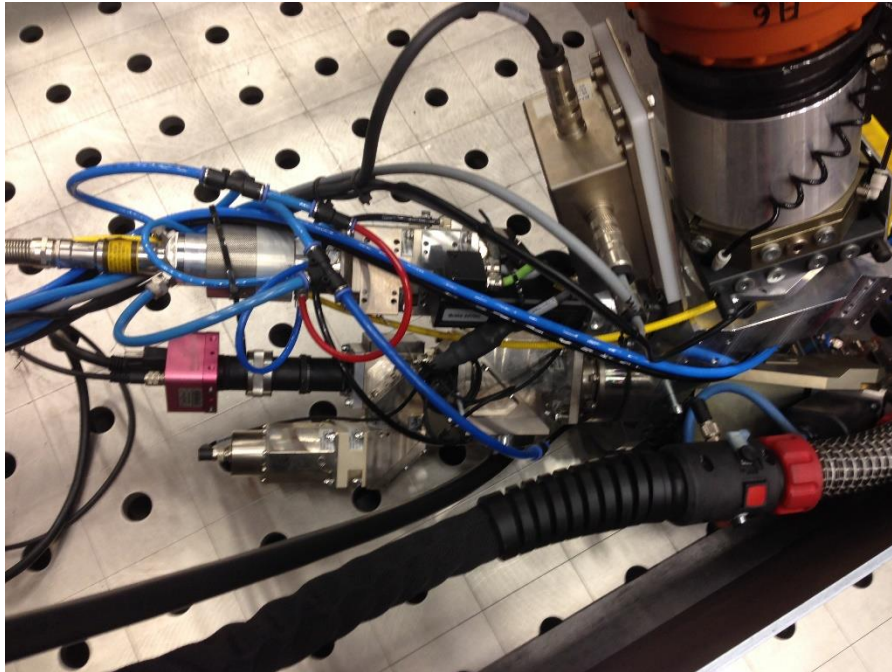
- Laser beam power = 16 kW
- Arc power = 5.6 kW + 5.6 kW
- Feed rate = 1.6 m / min
- Y seam preparation:
web height $h = 15 \text{ mm} + 5 \text{ mm bevel}$



LASER AND ARC

QUALITY ORINETED 3D LASER WELDING OF INNOVATIVE SHIP DESIGNS

Innovative processing head design guarantees good accessibility also under constraints and.....



LASER AND ARC

QUALITY ORINETED 3D LASER WELDING OF INNOVATIVE SHIP DESIGNS

...overall part geometry needs innovative gantry systems with positioning capability in μm accuracy and



Fraunhofer CLOOS Fraunhofer
ILT IAPT

PRECITEC

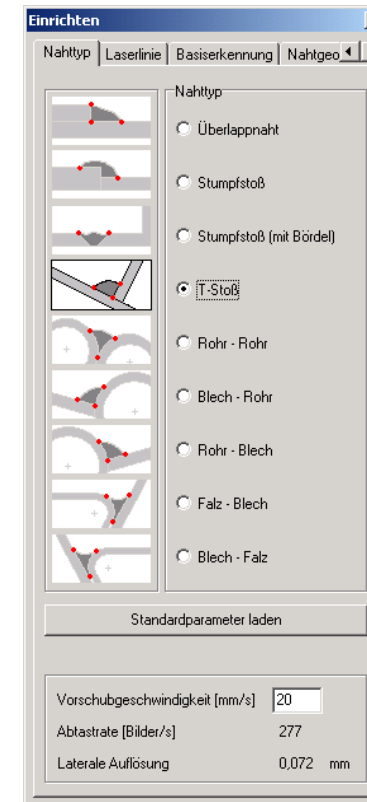
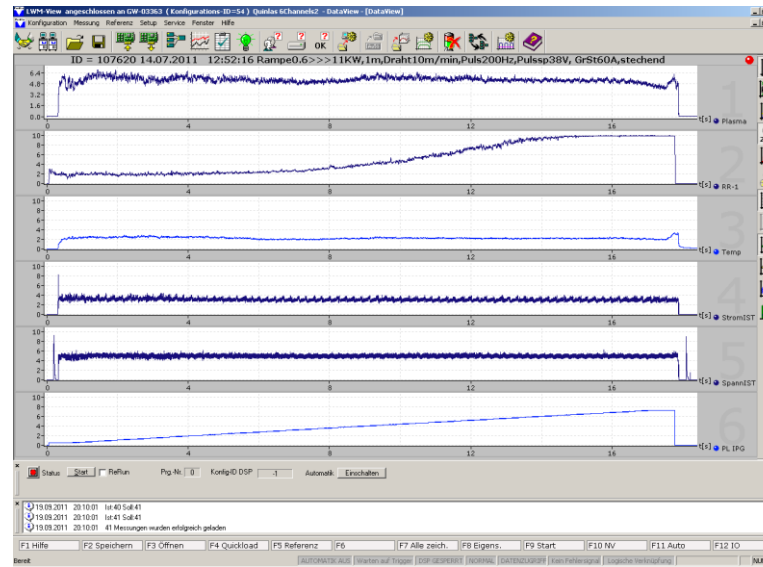
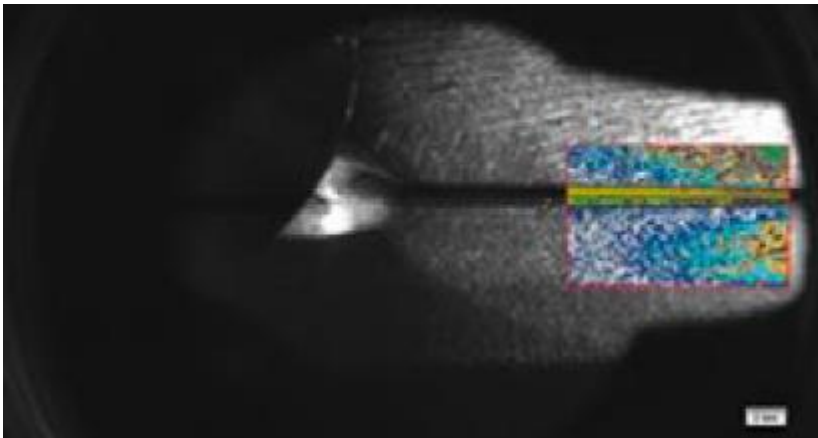
LASER AND ARC

QUALITY ORINETED 3D LASER WELDING OF INNOVATIVE SHIP DESIGNS

....quality demands ask for innovative sensor solutions and...

process emissions combined with arc parameters

texture-based joint position detection, tracking and gap width measurement

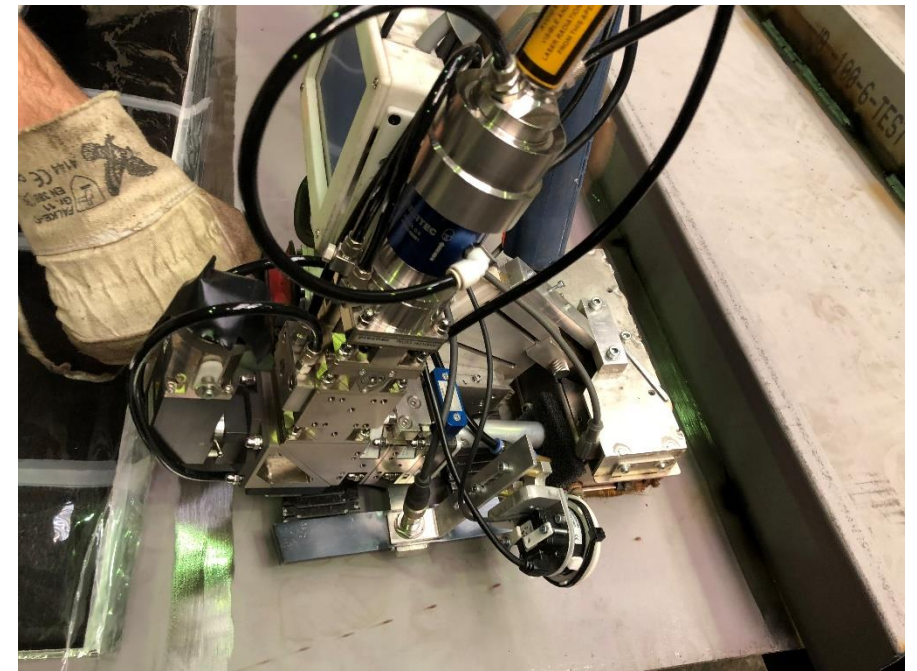
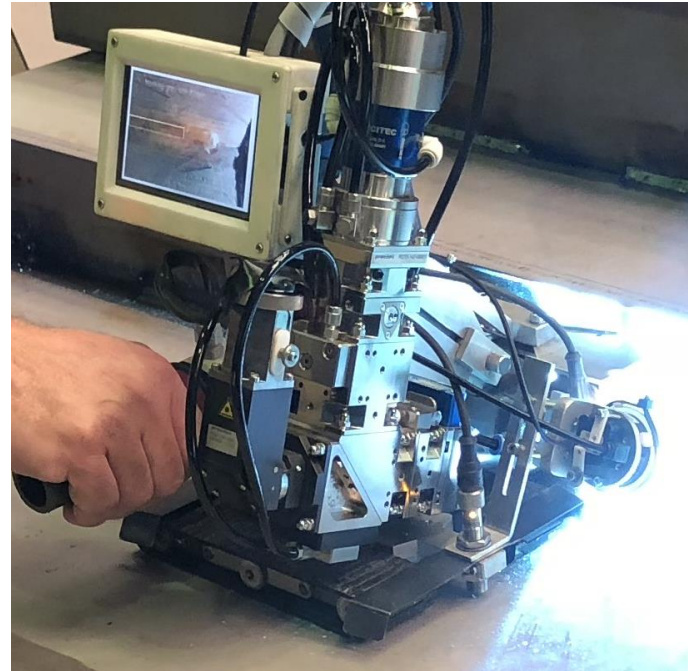


seam geometry measurement based on DIN EN 13919

LASER AND ARC

QUALITY ORINETED 3D LASER WELDING OF INNOVATIVE SHIP DESIGNS

....semi automated handheld solutions



THE PATH TO WEIGHT REDUCTION – DISSIMILAR MATERIALS

MORE ALUMINUM IN SHIPBUILDING INDUSTRY ASKS FOR STEEL ALUMINUM JOINT



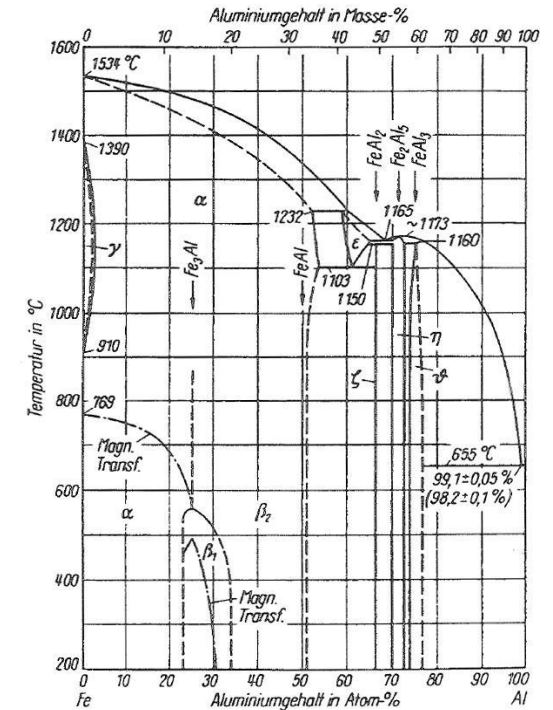
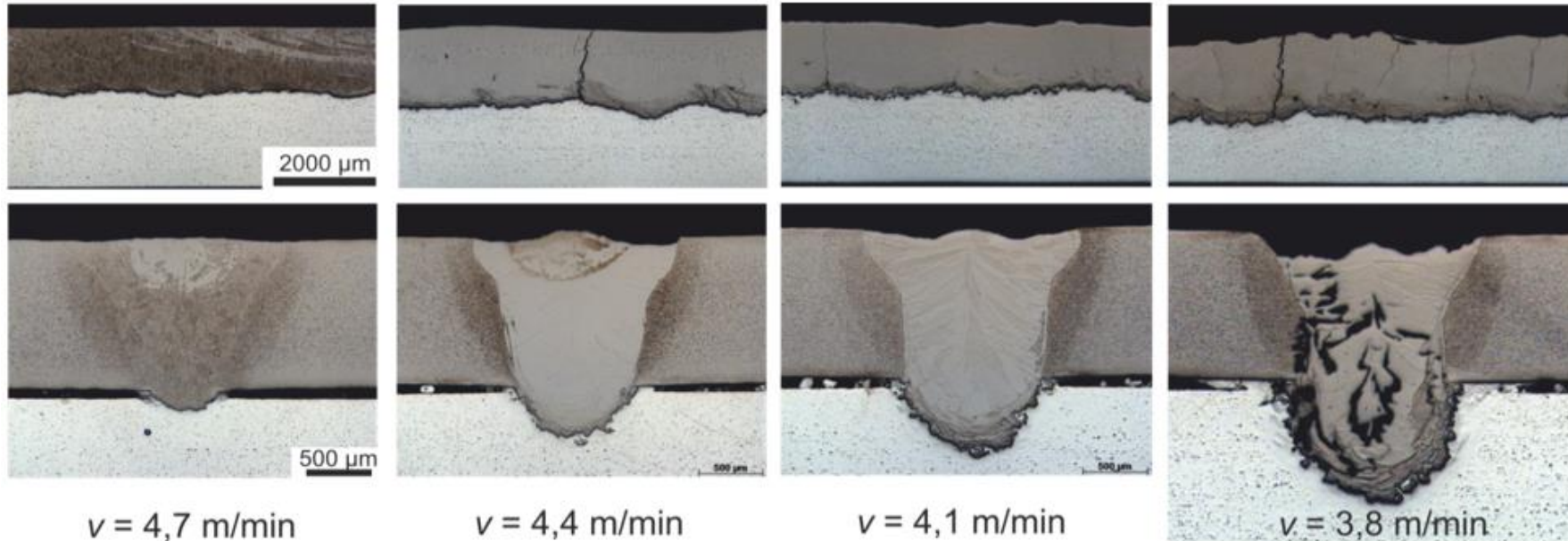
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Formation of intermetallic brittle phases (Fe_xAl_y)

→ Crack formation, low ductility, high hardness

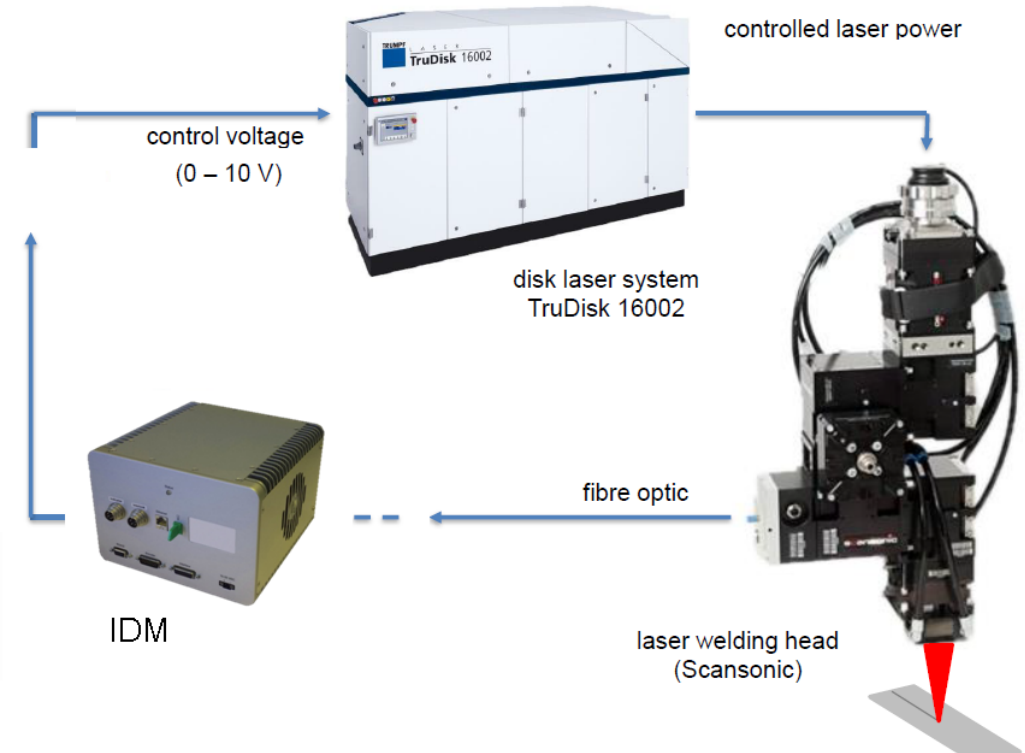
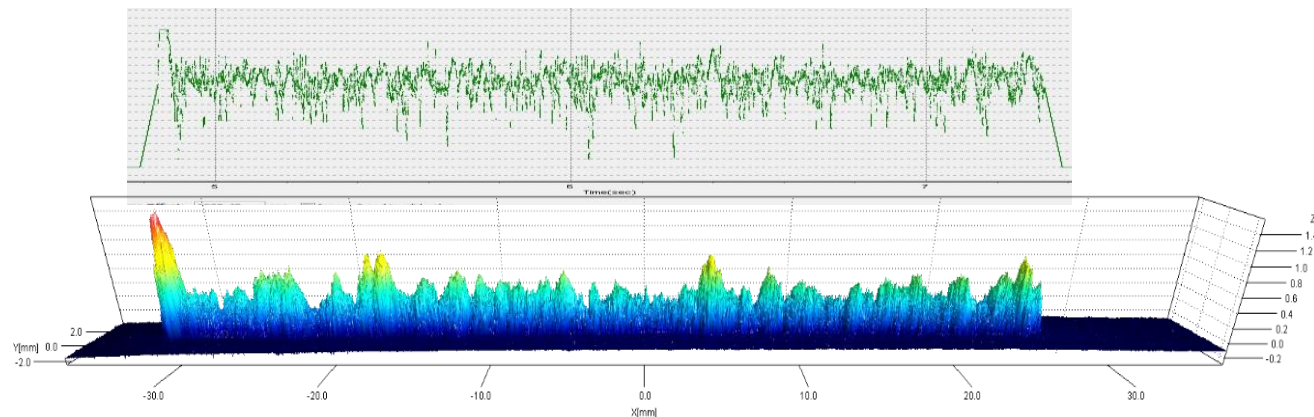
→ reduced mechanical load capacity



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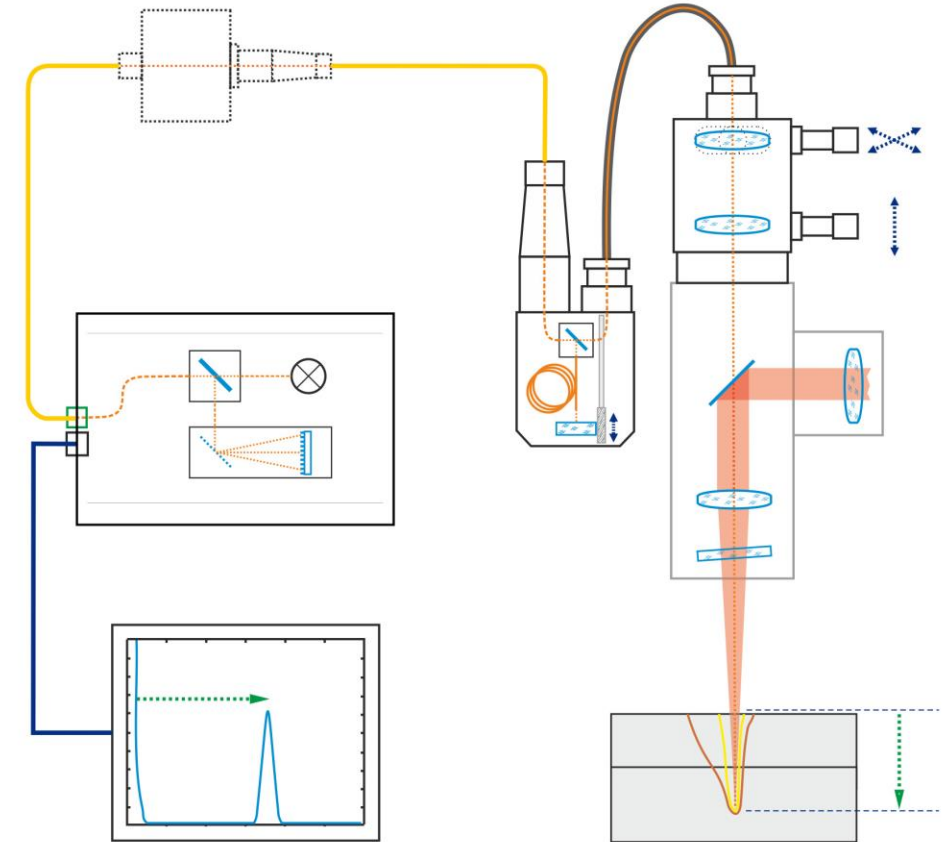
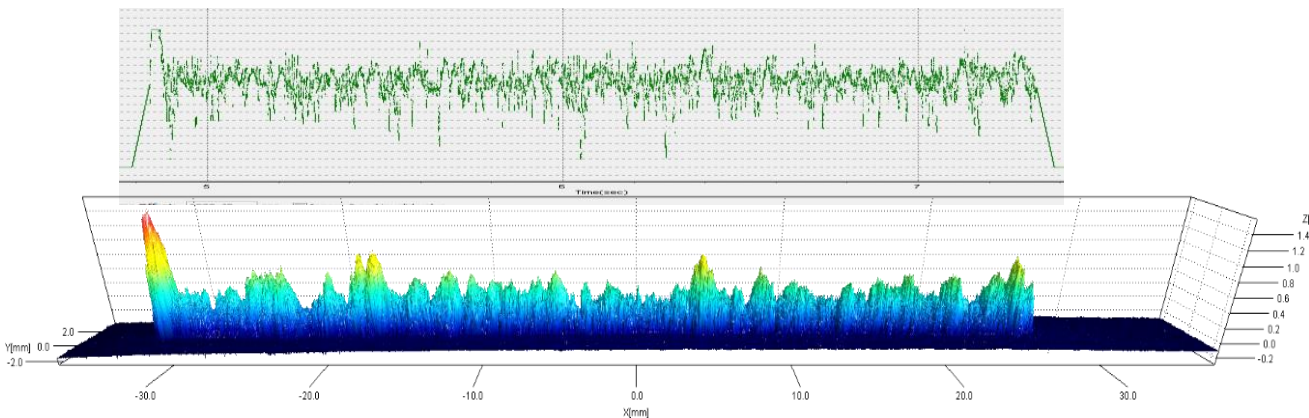
Possible solution: OCT keyhole depth control



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TAKE AWAY MESSAGES

- **Shipbuilding industry is continuously incorporating innovations but it is “a long and winding road”**
- **High complexity of the approaches is asking for joint projects with contributions from the relevant experts**
- **Precitec’s contribution is the expertise in processing heads – modular design is the turnkey solution to provide customer, machine and application specific solutions – and innovative sensor technology**
- **Precitec is a reliable and curious partner providing the required solutions at the end of the optical fiber for cutting, welding and additive manufacturing**

SPECIAL THANKS TO





**Thanks to EPIC for having me!
Any questions?**

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R&D Projects
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