Optical Seam Tracking: Advanced Applications

Theory and Application for Arc and Laser Welding

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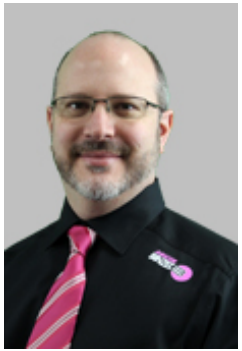
Optical seam tracking in arc and laser applicaitons

Panelists



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Optical Seam Tracking: Advanced Applications

Agenda

Basics of Optical Seam Tracking:

- What it is and what it does
- Laser Triangulation
- Data acquisition
- Transfer to motion control

How it Works in Application:

- Hard Automation
- Robotic Arc Welding
- Integrated to a Remote Laser

Overall Benefits For:

- Sub-arc Processes
- MIG Welding Processes
- Laser Welding Processes

- **Conclusions**
- **Questions**

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Quality Problems in Joining Technology

Tolerances: Component | Tooling | Joint Prep

Process Influences: Distortion During Welding | Inaccurate Robot / Machine

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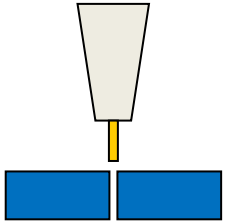
Ideal Situation vs. Real Situation

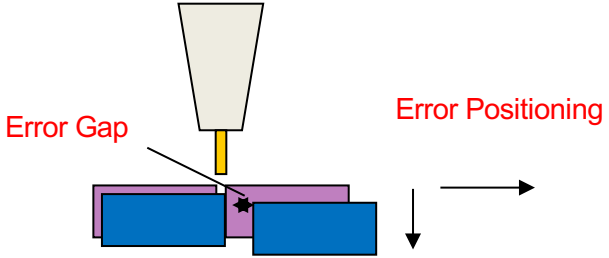
Ideal Situation



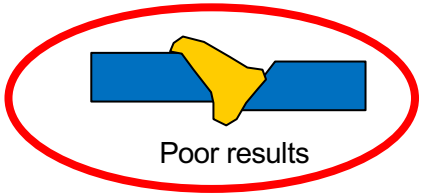
Normal joint and programmed position

Good results

Real Situation



Real position and programmed touch position

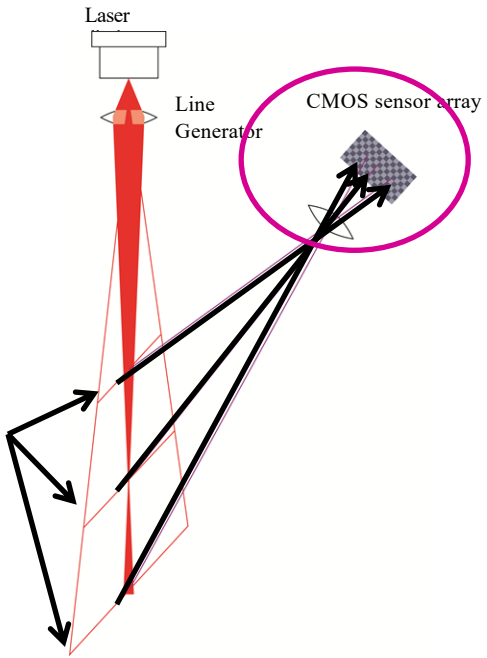


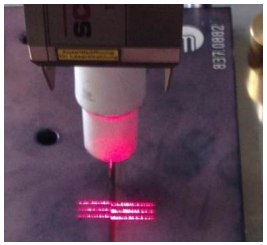
Poor results

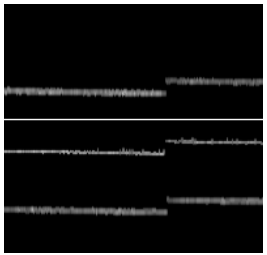
Machines need intelligence to detect changes and errors can be avoided

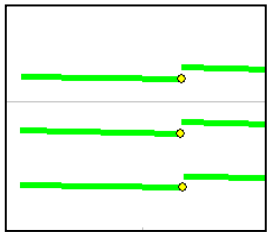
Optical Seam Tracking: Advanced Applications

Measurement Value – Adaption to Machine









- Triple Line Sampling Technic Orients to the Object
- Beam projects on to the part
- Beams reflects off surface back into the sensor
- Pixels filtered & summarized via CMOS
- Results in row data the represents a 3D contour of the scanned object

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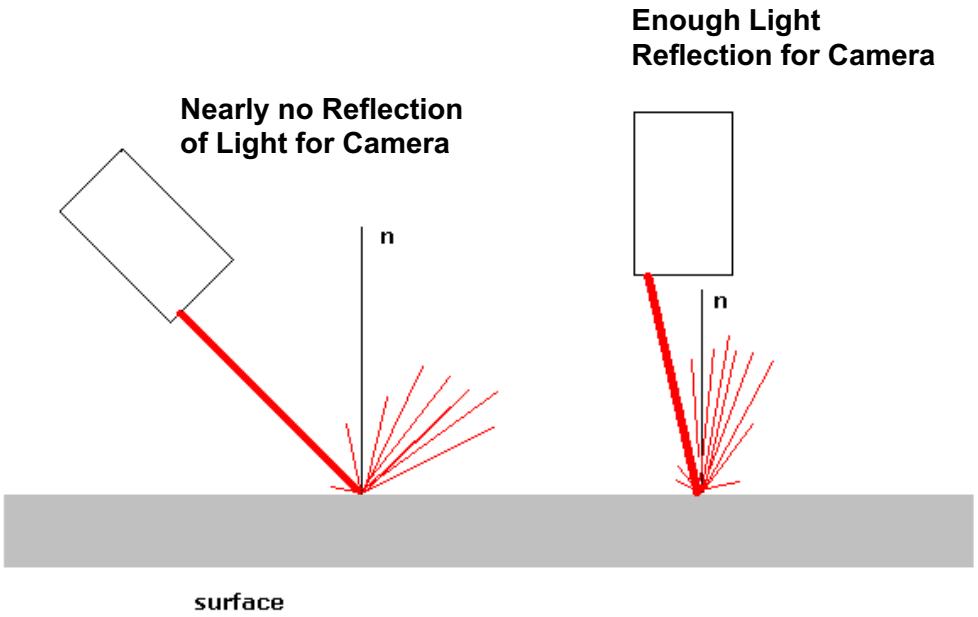
Optical Seam Tracking: Advanced Applications

Measurement Value – Right Reflection Angle

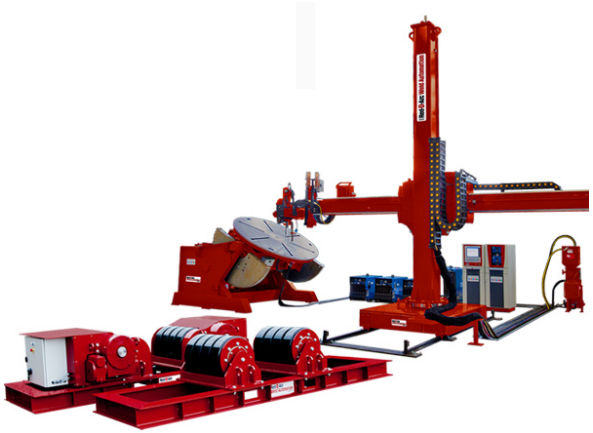


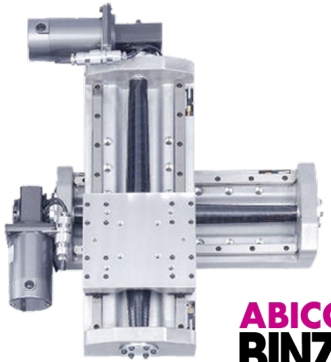
- Too Much Push Angle = Low Measurement Data
- Too Much Drag Angle = Low Measurement Data

Optical Seam Tracking: Advanced Applications

Hard Automation

- Booms, Gantries, Manipulators Gain Added Flexibility from Seam Tracking
- Adds Intelligence to Machine via Sensor Addition
- Typically Integrated to Motor Package via 10V or -/+10V Approach
- Retrofit capability via Bolt-on Options with Varying Slide Lengths (200, 300, 500 mm, etc.) – Controlled Independently





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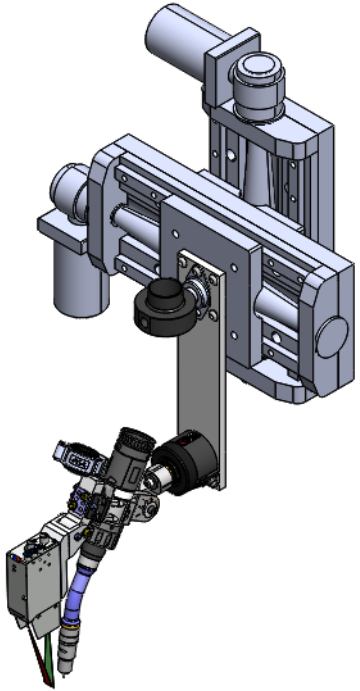
Optical Seam Tracking: Advanced Applications

Hard Automation

- Standalone Integrated Solutions Pair Slides with Drive Packages and Integrates Seam Tracking at Outset
- Typically Uses Pair of Slides, 200m Stroke in Y & Z with Base Slide Package Executing X Direction
- Consists of Main Control Panel, Touchscreen UI, Remote Pendant with Integrated Control, & Optimized Sensor Package
- Suitable IO Capacity for Comms to Existing to Execute Start/Stop, Positional Feedback, & Process Control



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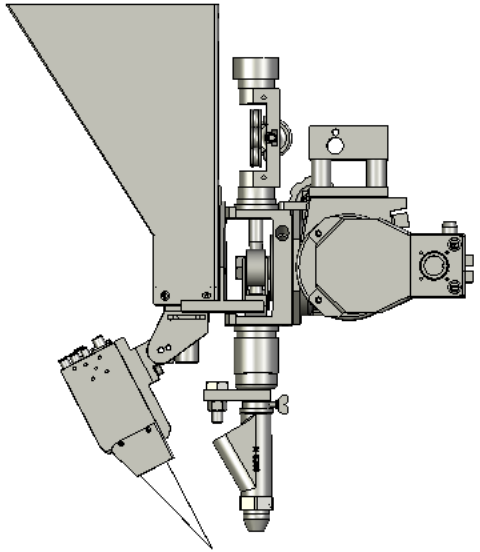
Optical Seam Tracking: Advanced Applications

Hard Automation – Options with Seam Tracking

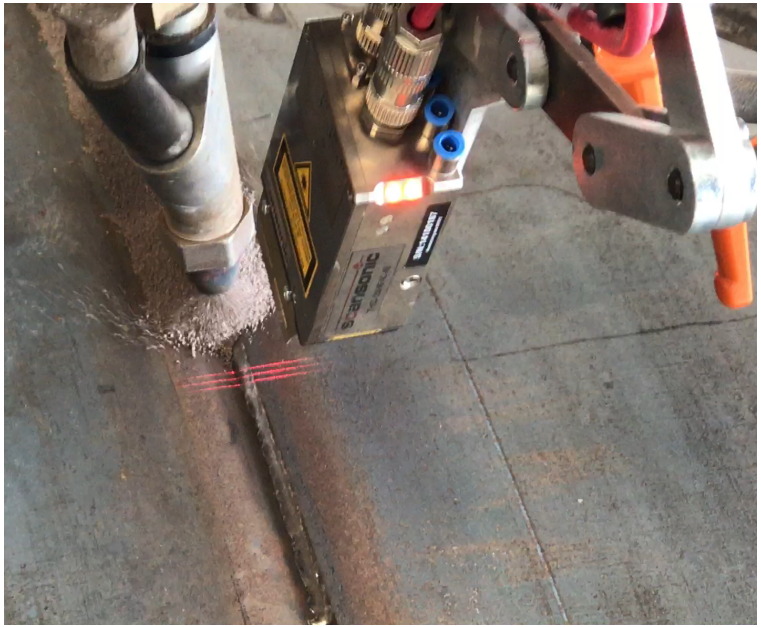
- Process Adaptable (MIG, TIG, Plasma, Sub-arc, Laser Welding Sealing / Dispensing)
- Added Slide Lengths for Larger Parts
- Select Motor Packages with Integrated Encoders
- Dual Package Paired with Single Controlled (Head / Tail Stock)



Optical Seam Tracking: Advanced Applications

Hard Automation

3D Laser Triagulation Seam Tracking With Hard Automation



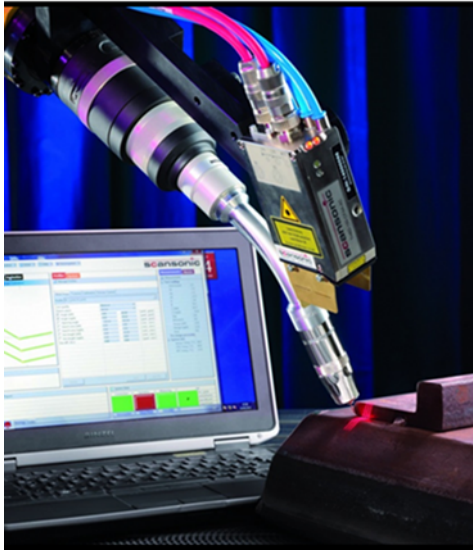
Optical Seam Tracking: Advanced Applications

Robotic Processing

- Robots are Highly Intelligent
- Processes Are Not – They Induce Variation
- Interfacing Technology to Robot Control Varies
- Many Follow Master / Slave Where Sensors Offset Path

Optical Seam Tracking: Advanced Applications

Robotic Processing – How it Works

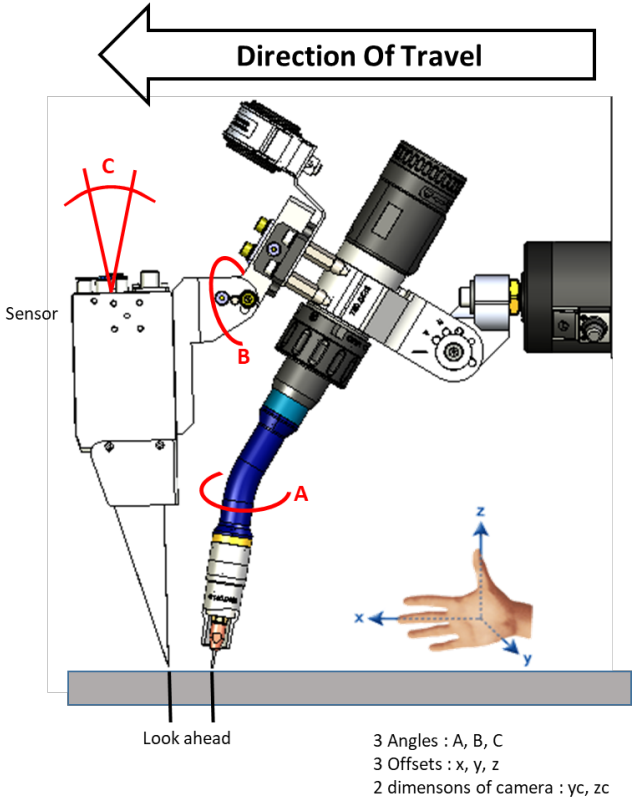


- Sensor Mounted & Given TCP Around Robot
- Sensor Software Utilized by OEM to Integrate and Interface
- Data Accumulated by Sensor, Transmitted to Robot, Data Parsed, Path Adjusted in Real Time
- PC-based Software Interfaces with Controller & Parameterizes Program the Robot Calls on for Tracking

Optical Seam Tracking: Advanced Applications

Measurement Value – Adaption to Robot

- Three Offsets & Angles: X, Y, Z and A, B, C
- YC and ZC Used for Path Correction
- Values Like Gap, Mismatch, Area, Flange Width Dictate Process Control

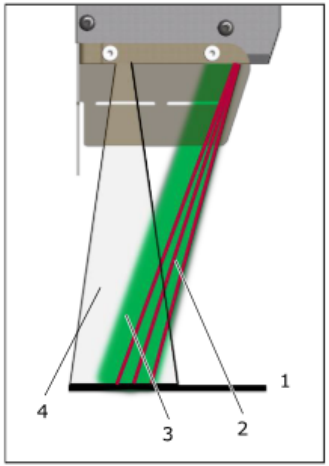


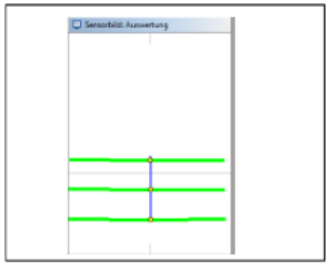
The robot has to know the orientation of the sensor to adjust his path correctly

The orientation is defined by a calibration routine in the robot

Optical Seam Tracking: Advanced Applications

Zero Gap Capabilities Approach



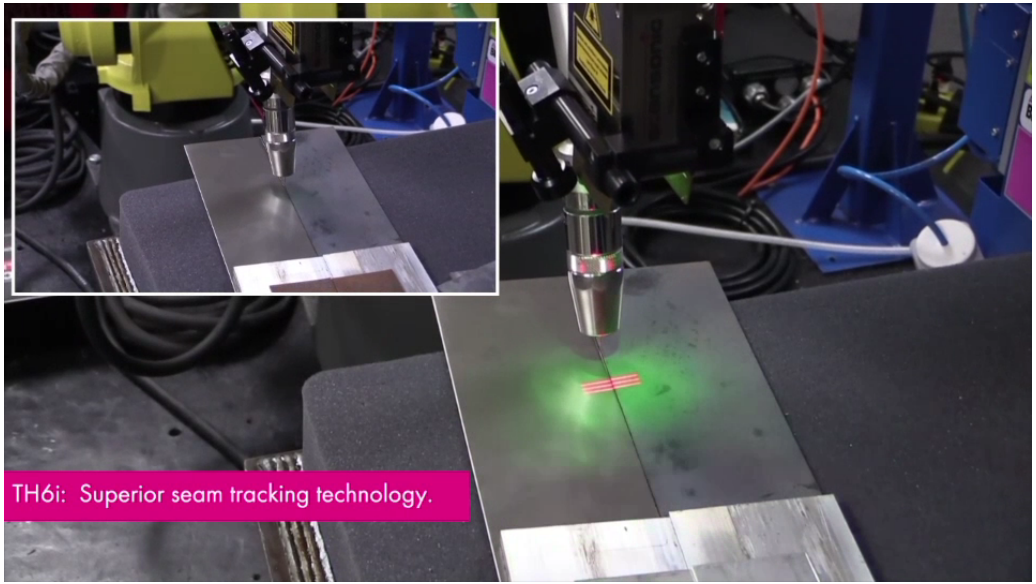


- Unique Challenge: No Joint Features to Track
- Functional Approach: Laser Triangulation Combined with Gray Scale Sensors

Optical Seam Tracking: Advanced Applications

Robotic Processing

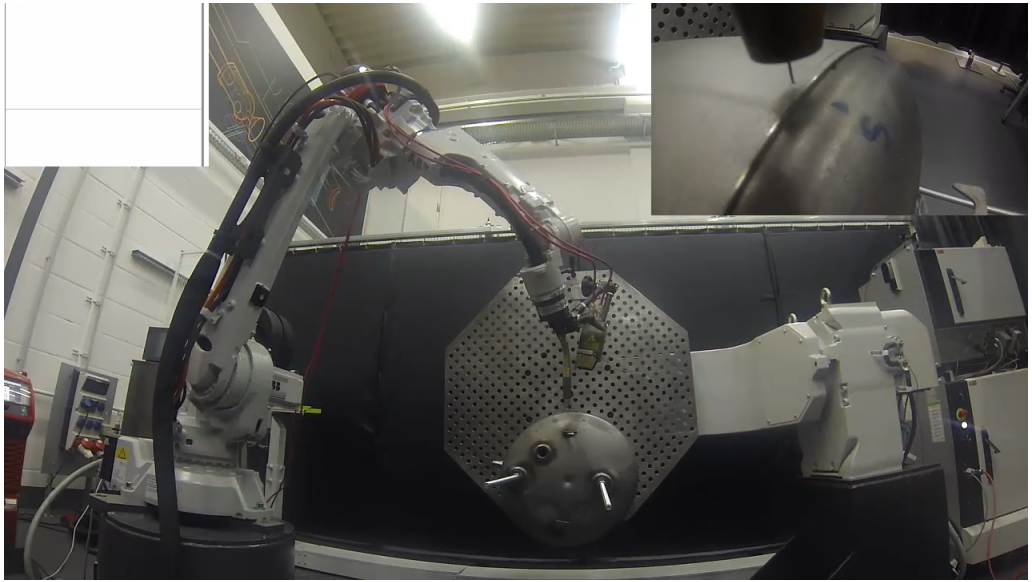
3D Laser Triagulation Seam Tracking With Robotics



Optical Seam Tracking: Advanced Applications

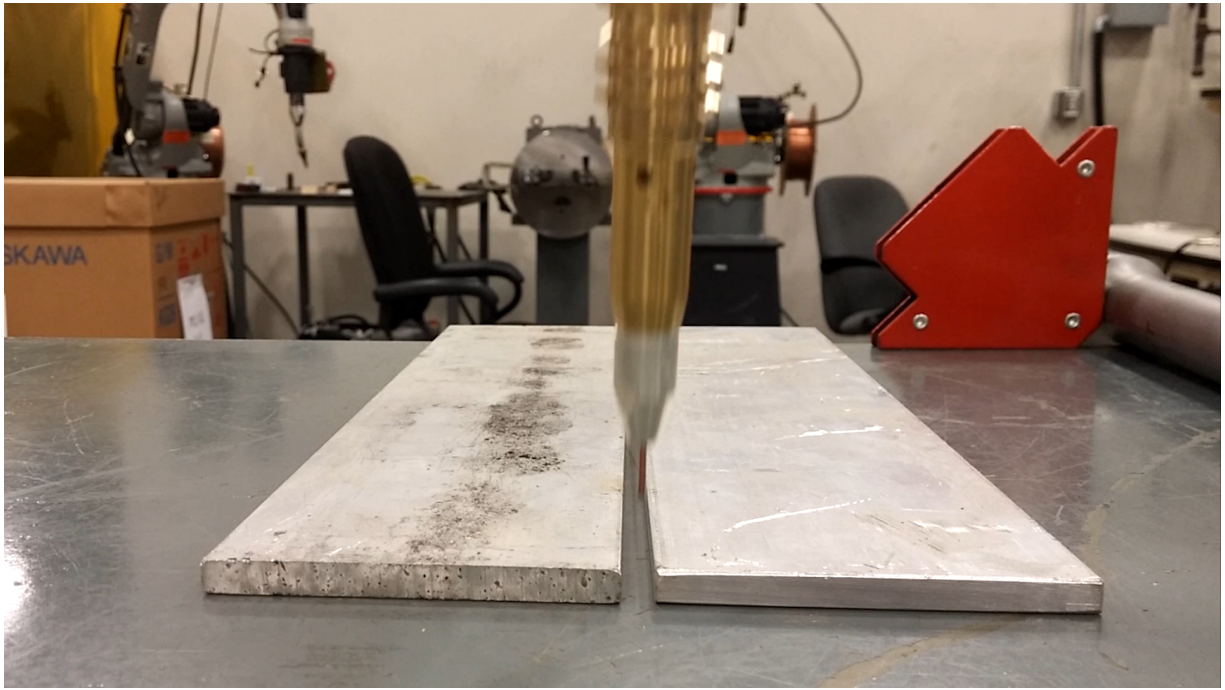
Robotic Processing

3D Laser Triagulation Seam Tracking With Robotics



Optical Seam Tracking: Advanced Applications

Robotic Processing



- **Gap Data** – System Applies Adaptive Algorithms
- **Adjustment** – Weaves, Travel Speeds, WFS, Voltage
- **Filtering** – Tracks and Adjusts on Reflective / Shiny Surfaces

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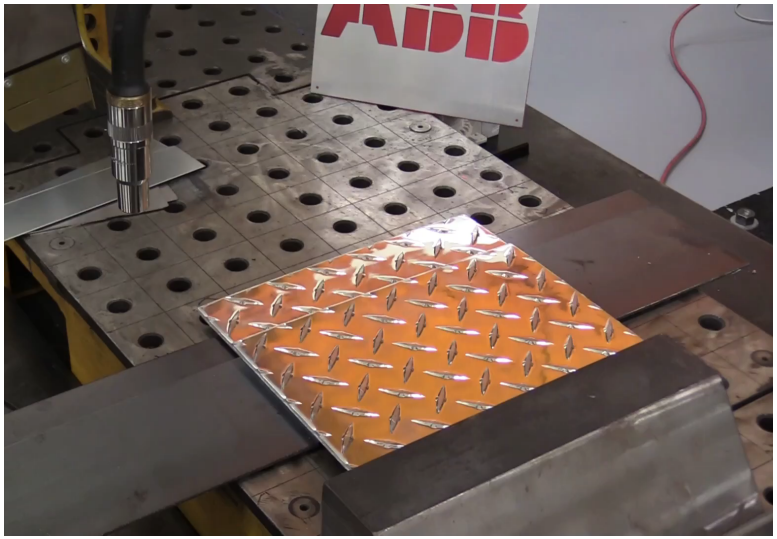
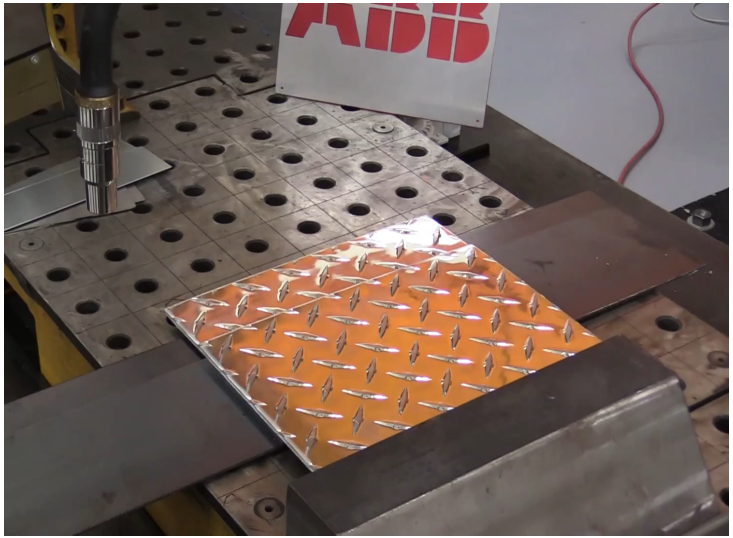
Robotic Processing





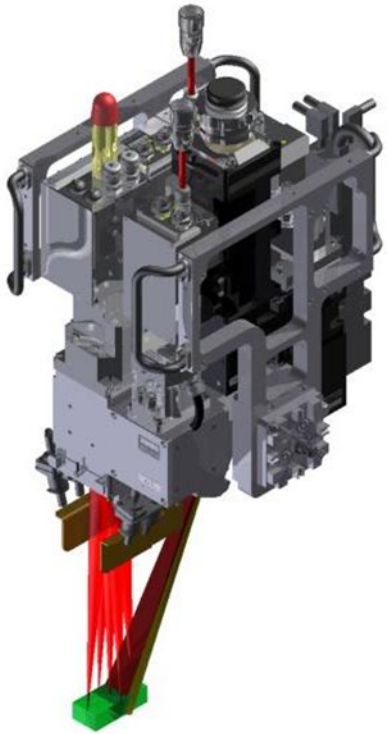
Programmed Part (with Seam Tracking)

Taught Path (Robot Only)

Optical Seam Tracking: Advanced Applications

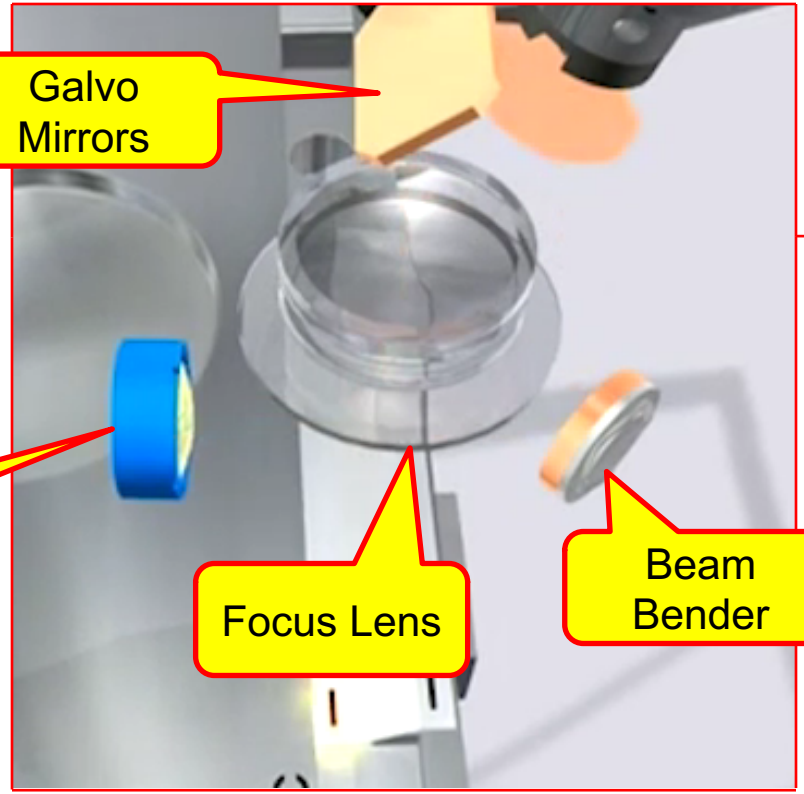
Integrated into Laser Optics – Triangulation-based

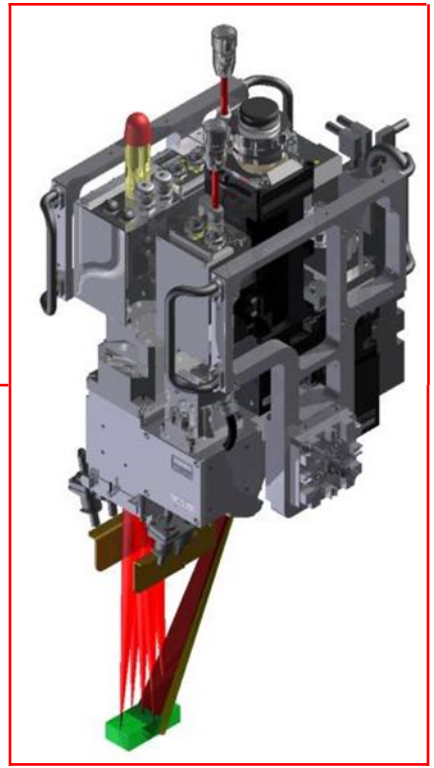
- Seam tracking can be directly integrated into stand alone devices that are able to gain the advantages of positional intelligence.
- As is the case with hard automation and robotic applications, the seam tracking solution is used to drive motor position to guide the outcome of the process.
- Same can be said with galvo motors located within laser welding optics.
- In this approach, you no longer rely on point and shoot mentality, but have the inherent ability to place the laser beam exactly where the joint and material dictates



Optical Seam Tracking: Advanced Applications

Integrated into Laser Optics – Triangulation-based





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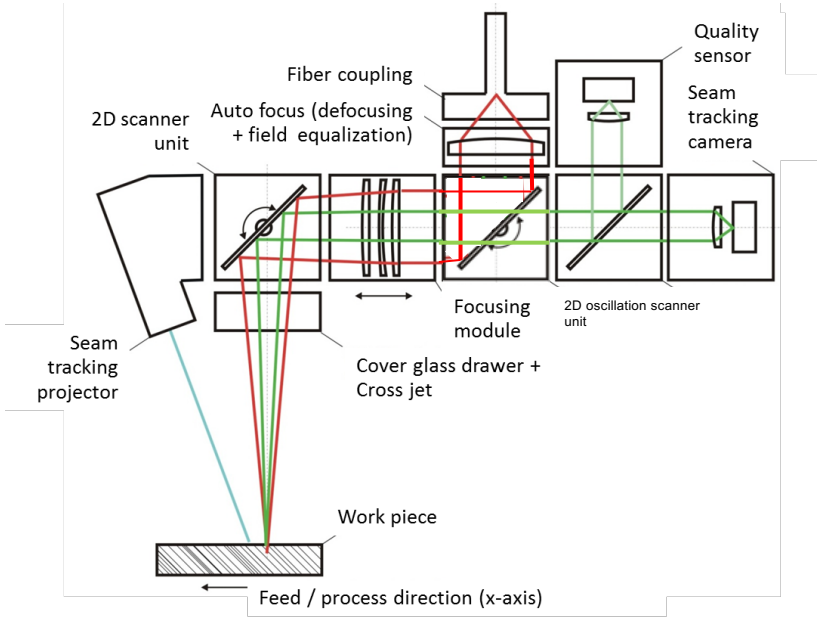
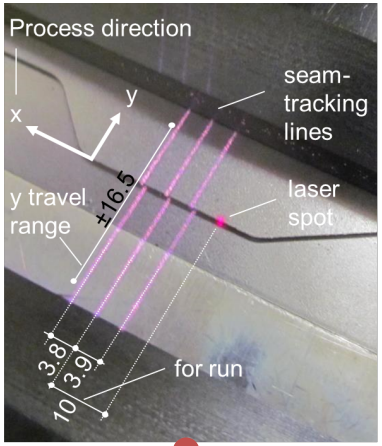
Optical Seam Tracking: Advanced Applications

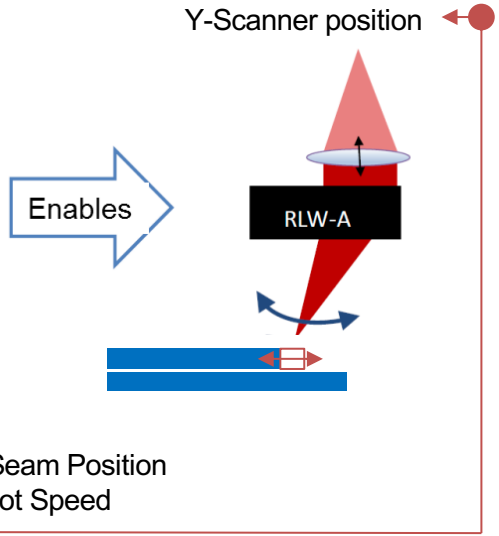
Integrated into Laser Optics – Triangulation-based: How it works

Optical Setup:



Adaptive Seam Tracking Algorithm





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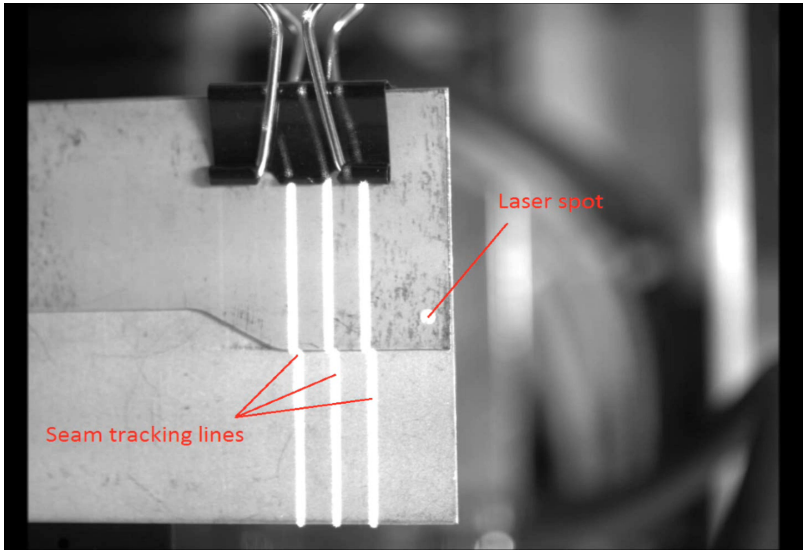
Optical Seam Tracking: Advanced Applications

Integrated into Laser Optics – Triangulation-based: How it works

- Works for Robot in Motion
- Very High Speed Movement Possible
- 3D Triangulation Enables 6D Measurement & Reliable Signals with High Redundancy
- Compensates Scanner / Sensor Misalignments & Maximizes Precision and Fault Tolerant
- Pre-objective Scanning = High Sensor Accuracy



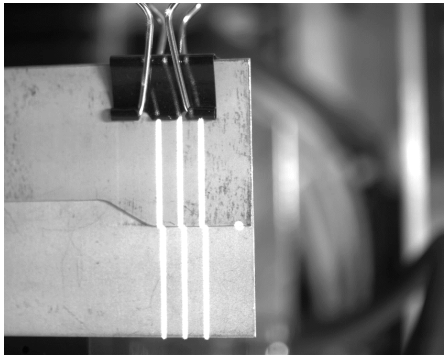
Optical Seam Tracking: Advanced Applications

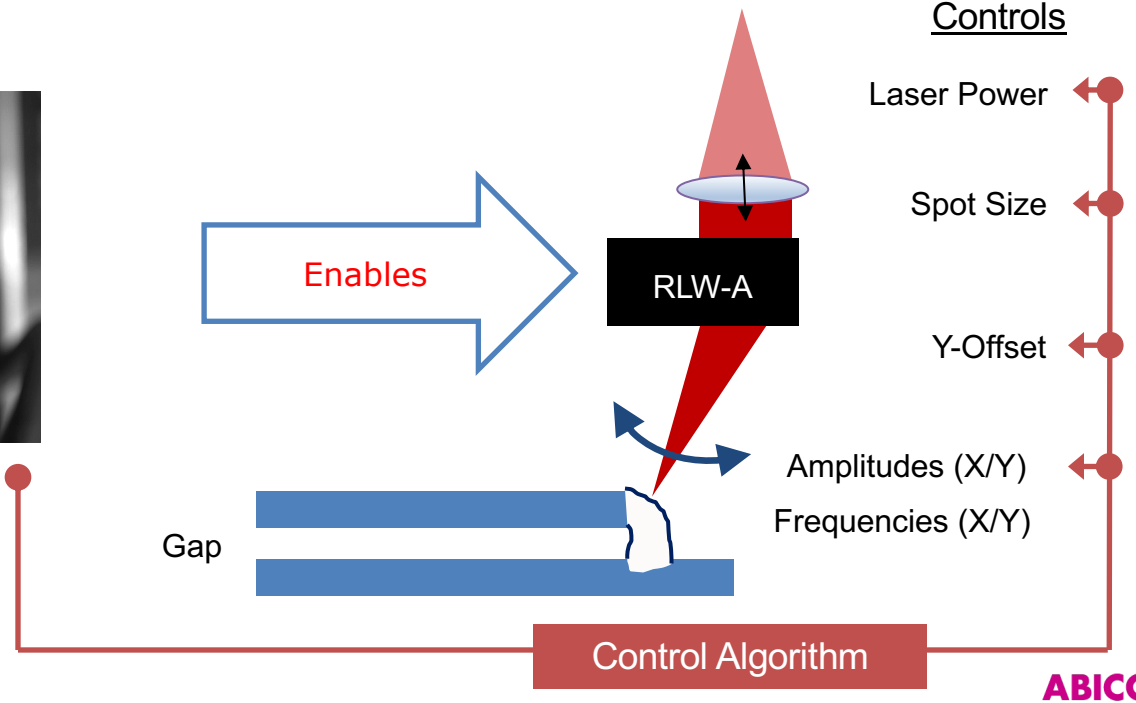
Integrated into Laser Optics – Welding of Steel Doors

- BMW: Steel Door Welding in Serial Production

Optical Seam Tracking: Advanced Applications

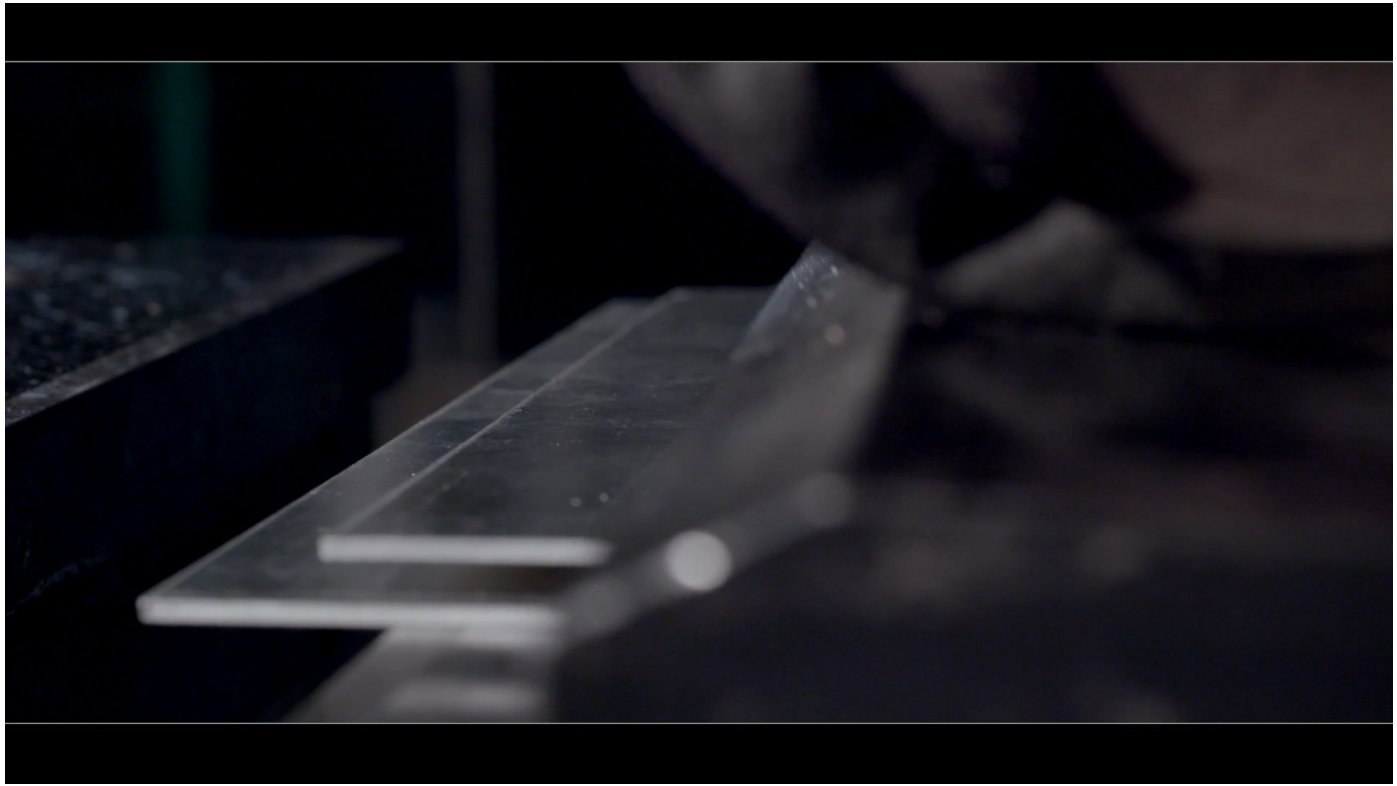
Integrated into Laser Optics – Automated Gap Bridging





Optical Seam Tracking: Advanced Applications

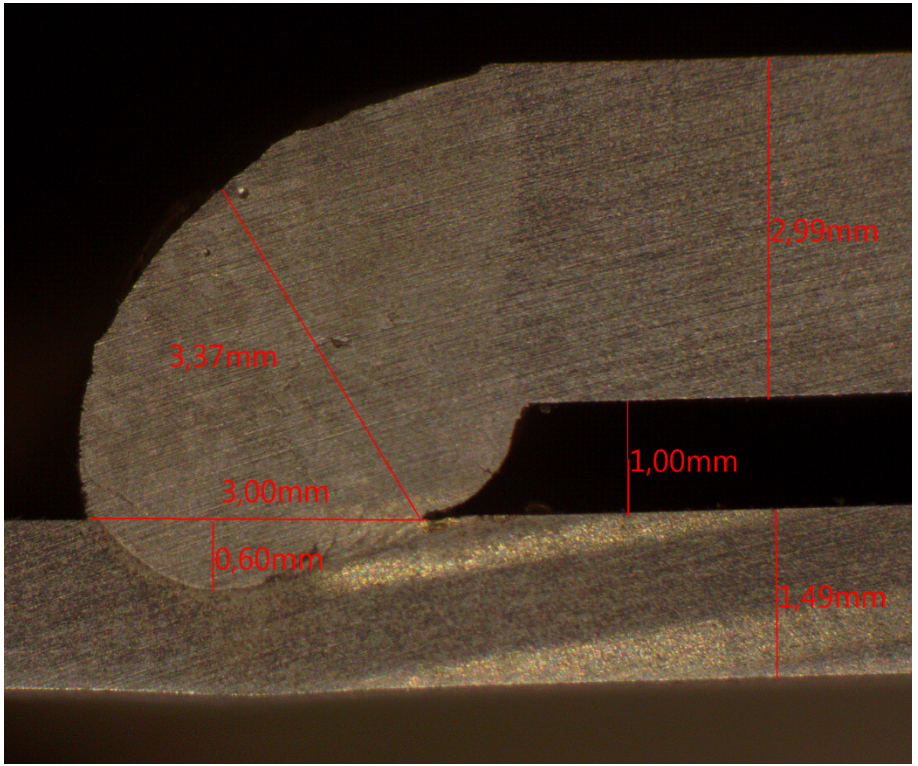
Integrated into Laser Optics – Automated Gap Bridging



- Aluminum Gap Bridging with Oscillation

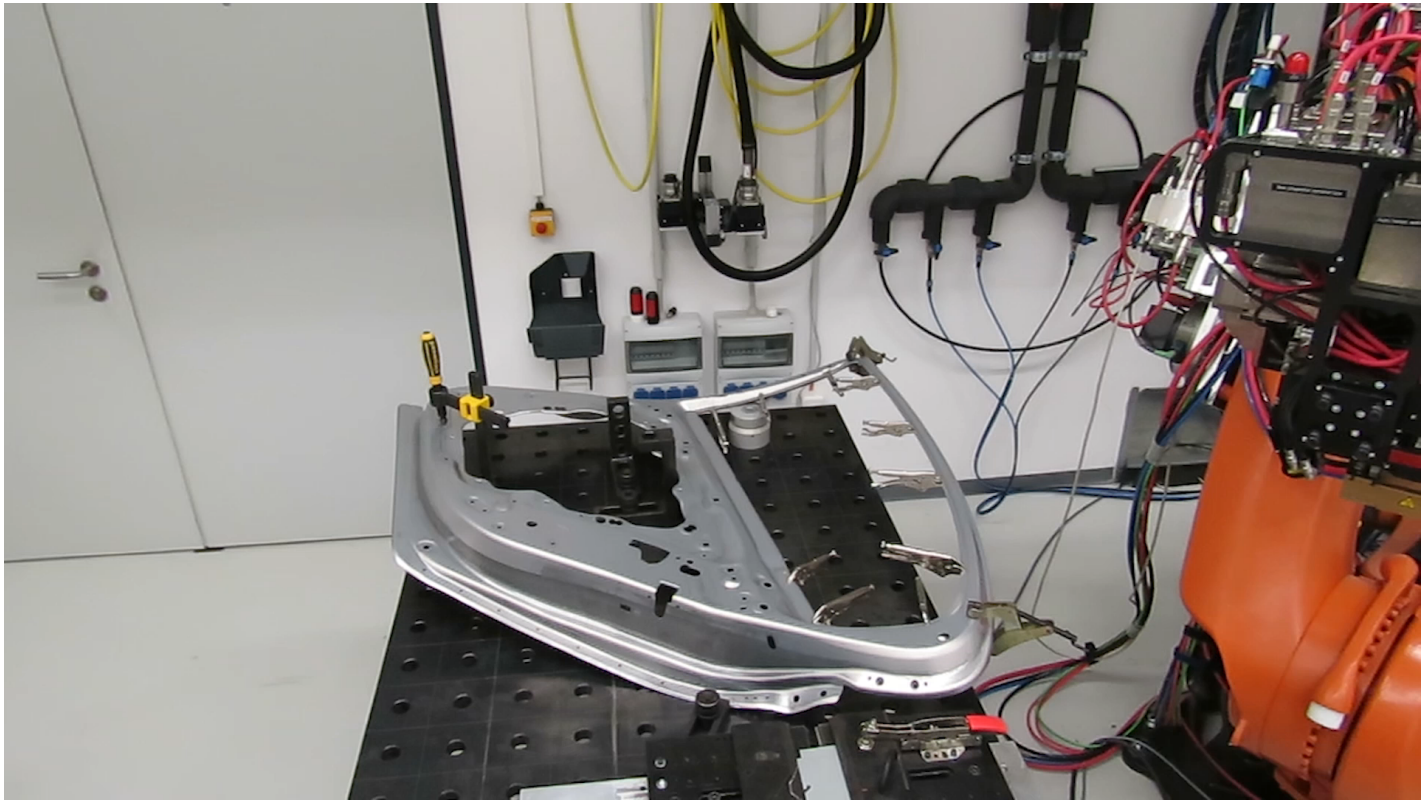
Optical Seam Tracking: Advanced Applications

Integrated into Laser Optics – Automated Gap Bridging Results



Optical Seam Tracking: Advanced Applications

Integrated into Laser Optics – Welding of Aluminum Doors

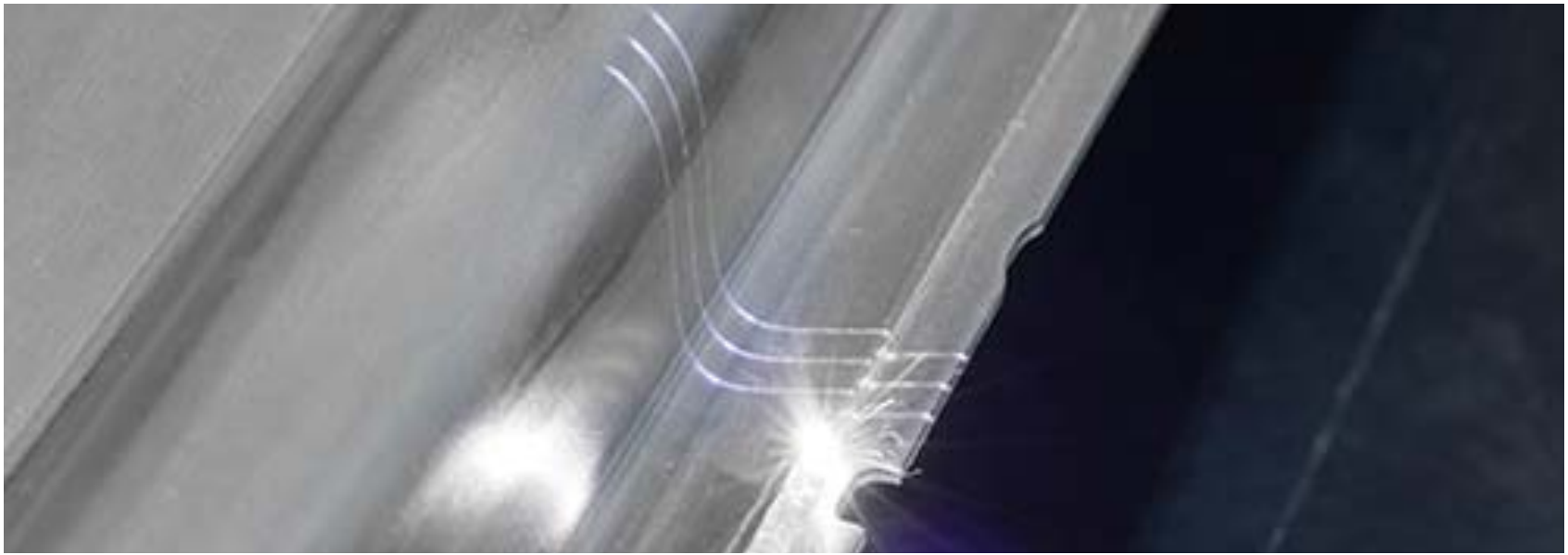


Optical Seam Tracking: Advanced Applications

Integrated into Laser Optics – Welding of Aluminum Doors







QUESTIONS?

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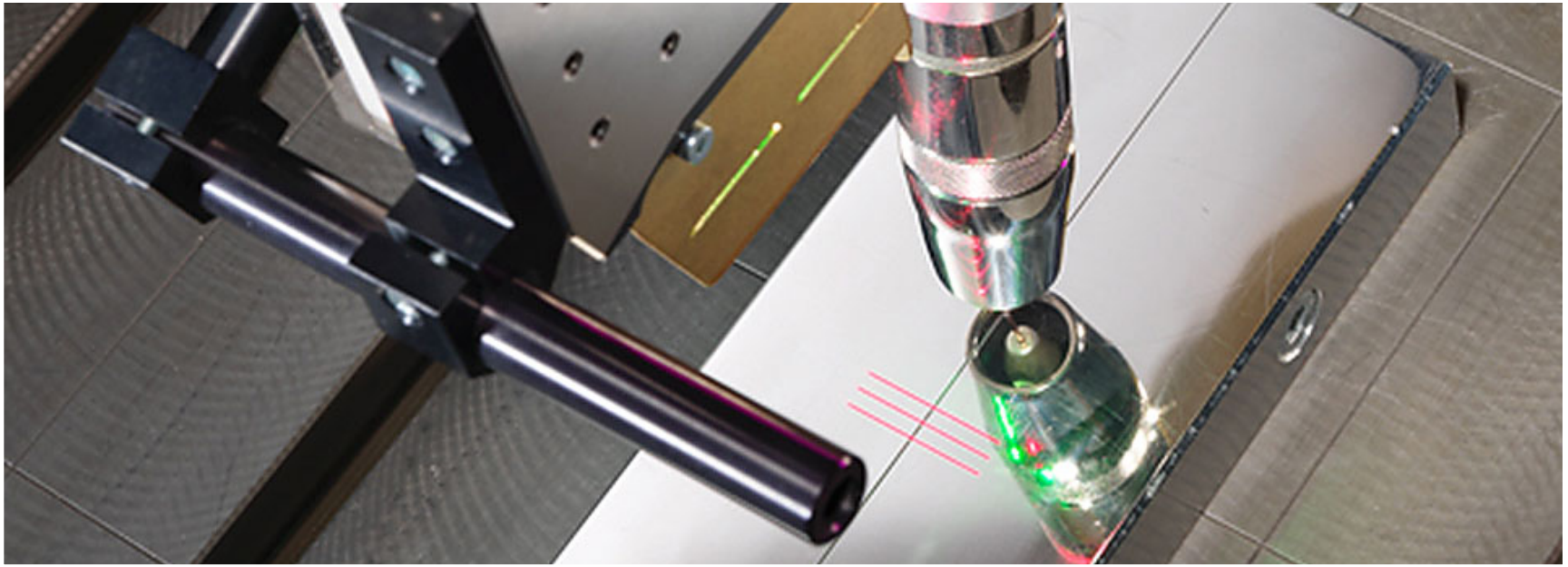

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