



# i<sup>3</sup>LasWeld-QA

## Inline Laser Welding quality assessment

The Laser Welding inline quality assessment system based in infrared imaging technology (i<sup>3</sup>LasWeld-QA) has been developed as a key enabling technology for different industries with an aim of a zero-defect manufacturing and process optimization.

The system is a real-time defect detection system, integrated in the production line, for laser welding processes based in the use of uncooled infrared imaging sensors working in the MWIR range, capable to operate at frame rates up to 1 kHz.

The sensor is coupled directly to the welding head allowing an on-axis stand-off observation of the process area. Melt pool images are acquired during the laser welding process and analysed on-line in order to assess in real-time the quality of the process. The recorded data is available for offline analysis.

Suitable for CO<sub>2</sub>, Nd:YAG, diode and Yb:YAG laser sources.

### Main specifications

- Optical coupling on to standard laser welding heads
- Inline quality assessment of the process
- Real-time analysis and defect detection
- Defects: holes, pores, lack of penetration, false friend, lack of fusion, underfilling
- Welding configurations: overlap joint, butt weld, fillet weld

### System components

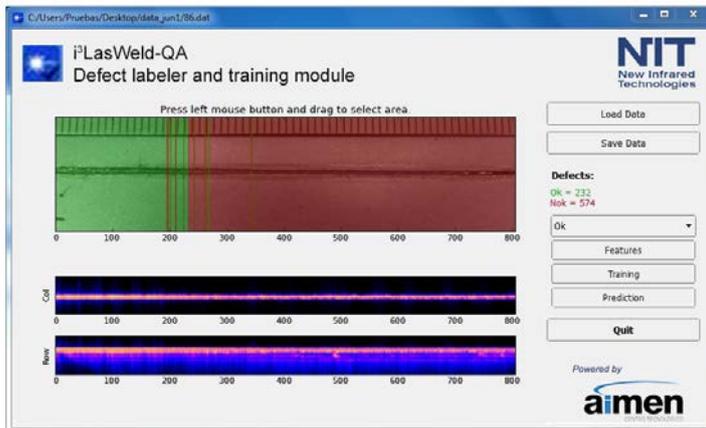
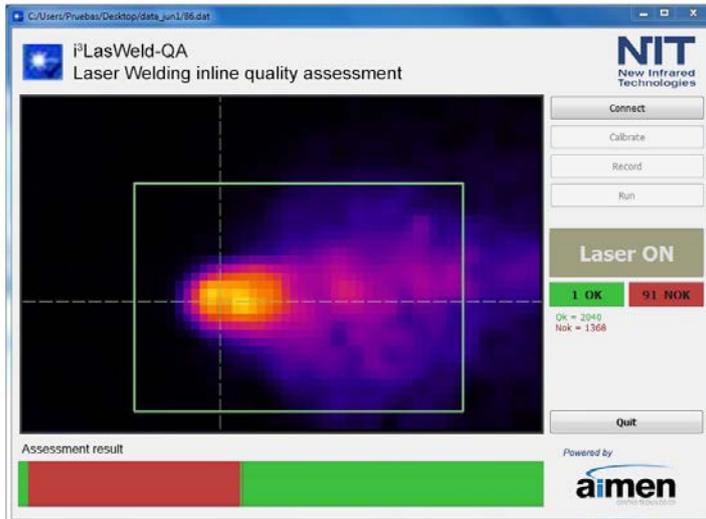
- Infrared imaging sensor coupled directly to the laser head
- Processing unit

## Processing software

The i<sup>3</sup>LasWeld-QA system relies on a specific software for defect detection, which is based on supervised-learning strategies in order to detect defects. The software package includes applications for inline monitoring, offline monitoring and training.

Main capabilities:

- Real time processing up to 1000 images per second
- Inline diagnosis and defect counting
- Real time information visualization
- Process data recording
- Offline monitoring
- Labelling and training



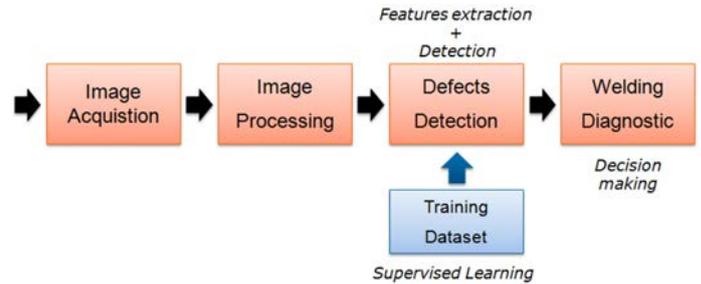
Screenshots of the i<sup>3</sup>LasWeld-QA software. Above: Acquisition window where the quality assessment of the laser weld is performed in real-time. Below: Analysis window with a visible image of the weld and the overlaid defect areas.

## Performance of the system

Configuration:

- Laser: Yb:YAG, 1.064  $\mu\text{m}$ , 16 kW
- Welding head: Trumpf-BEO D70
- Type of welding: overlap joint
- Materials: DP 600 Galvanized steel sheet, 0.8 mm + 1.5 mm
- Defects detected: lack of penetration, false friend (lack of fusion), holes / pores

Results: Defect detection rates higher than 99% (OK/NOK weld classification)



## Technical specifications

Optical sensor	Uncooled infrared imaging module TACHYON 1024 microCORE
Infrared band of detection	MWIR (1 - 5 microns)
Image resolution	32x32 (pixel size: 135 $\mu\text{m}$ x 135 $\mu\text{m}$ )
Frame rate	1,000 images per second
Communication	USB 2.0 High-speed (480 Mbps) M12 Mini-B USB connector with locking mechanism (IP67 for water and dust protection)
Power	5 VDC, 500 mA (over USB interface)
Enclosure	Ruggedized IP67 compact mechanical enclosure
Optical interface	CS-mount
Dimensions (mm)	46 x 39 x 29
Processing unit	Industrial PC, with the following configuration: Intel Dual Core i5 processor @ 2 GHz and 4 GB of RAM
Defects	Holes, pores, lack of penetration, false friend, lack of fusion, underfilling

