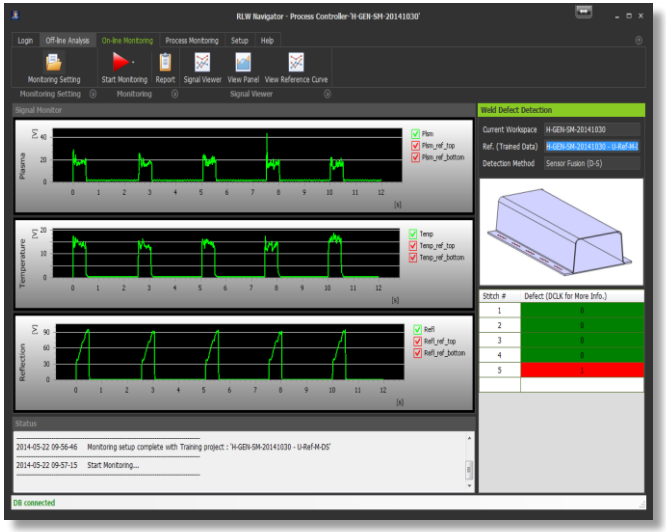
Process Monitoring & Weld Fault Classification Module

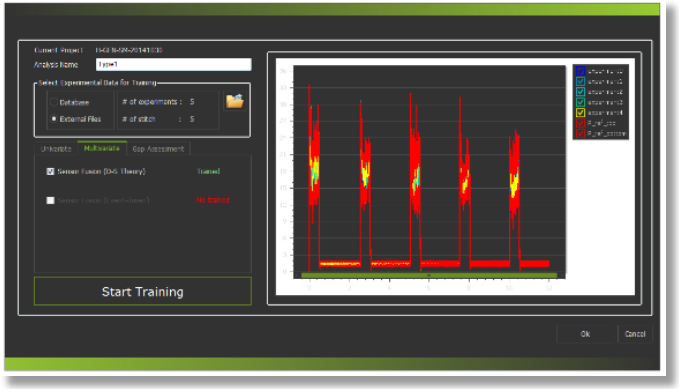
What is it?

- A RLW process monitoring software that is capable of identifying weld faults and estimating part-to-part gap by real-time analysis of in-process monitoring signals (e.g. plasma, temperature, reflection)



What does it do?

- Advanced statistical off-line analysis of weld defects in laser welding
- Online laser welding process monitoring based on multi-sensor information
- Process parameter (laser power and feed rate) adjustment in accordance with the estimated part-to-part gap



Benefits

- Rapid and seamless weld defect identification
- Guarantee joining quality and further reduce costs for post-weld analysis and treatment
- Weld fault prevention in a batch of parts by adaptive process adjustment

Verification & Validation

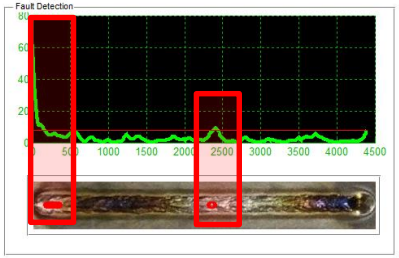
Experimental tests

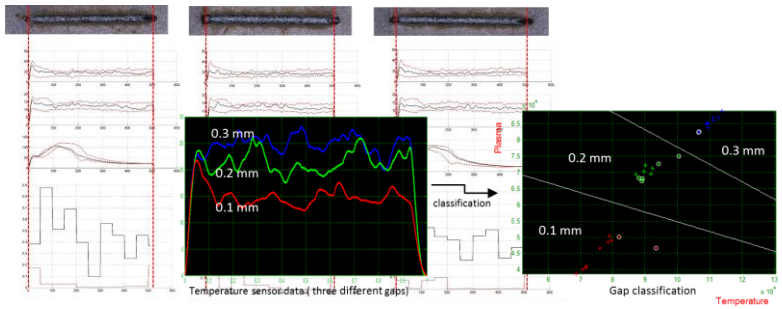
- Over 1000 coupon tests to identify the correlation between weld quality and weld signals
- Over 100 tests of real side-member parts (10 stiches/part)
- Tests using multiple laser welding systems: 2KW fiber laser and 6.6KW disk laser

The laser welding systems: (a) 2kW fiber laser (left): 2.5-axis gantry machine with IPG YLS-2000 (2.0mm*mrad beam quality), (b) 6.6kW disk laser welding system (right): 5-axis KUKA robot with TRUMPF TruDisk6602 (8.0mm*mrad beam quality)

Test results

- Improved performance of weld fault detection : statistically acceptable ‘miss’ or ‘false alarm’ : less than 0.1%
- High accurate estimation of part-to-part gap: ±0.05mm

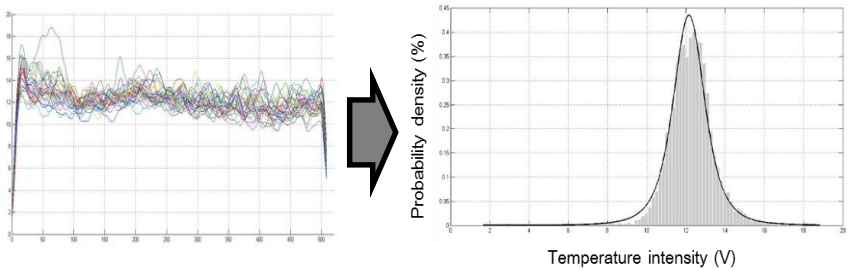




Novelty

Academic aspects

- Nominal weld signal modelling by pdf estimation
- Dempster-Shafer theory based uncertainty handling
- Multi-dimentional discretization based information amplification



Industrial aspects

- Rapid & accurate weld fault detection using multi-sensor fusion technique
- Semi-automatic detection threshold generation by the ANN, D-S modelling, and Eventization
- Weld fault prevention in a batch of parts by adaptive process adjustment
- Client/Server system