



Laser ultrasonics for quality control of resistance spot welding

Anton Jansson, Mikael Malmström, Peter Lundin

anton.jansson@swerim.se

Comparative study

- Laser ultrasonics (LUS)
- Tessonic RSWA
- Destructive testing – peeling test

Performed at Swerim

Performed at industrial partner

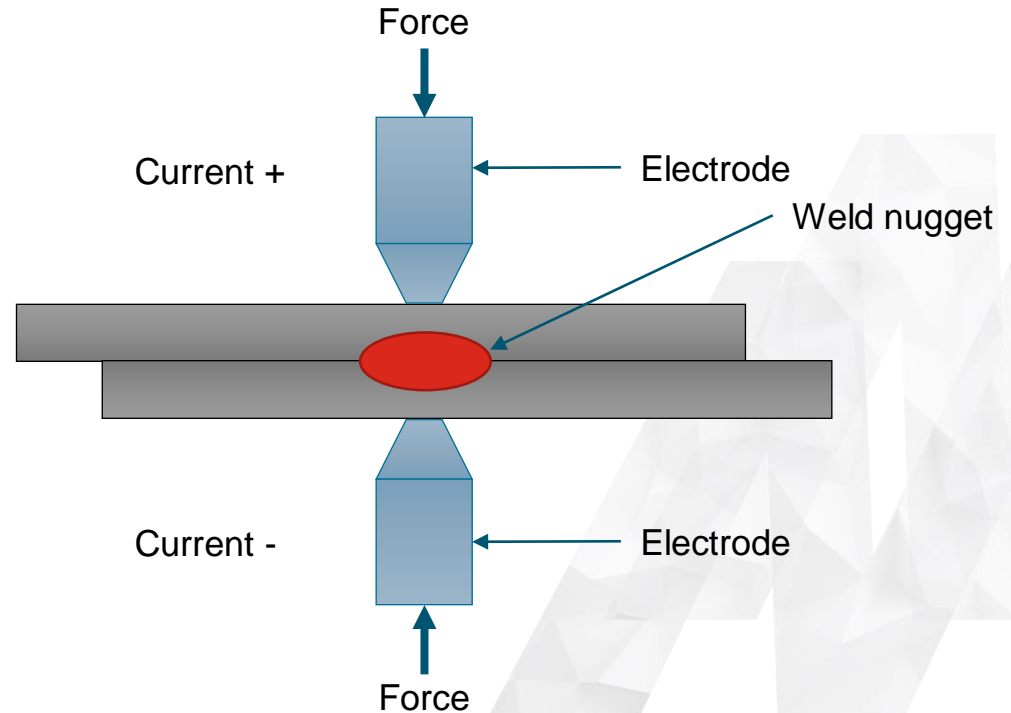
Performed at industrial partner



Resistance spot welding (RSW)

Mainly used in the automotive industry for joining metal sheets (2-4 sheets)
One car contains typically around 5000 spot welds.

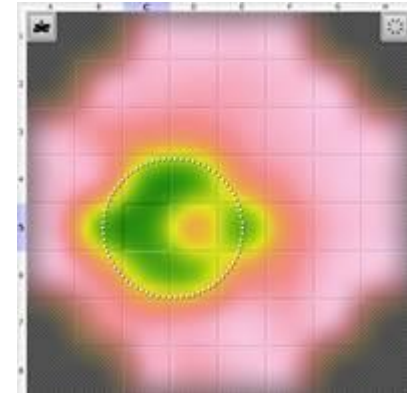
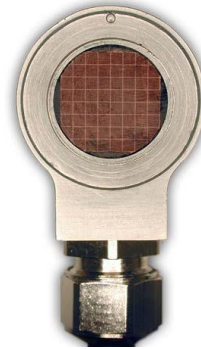
- ✓ Easy and economic
- ✓ Fast (< 1s)
- ✓ Multi-material combinations



Quality control of RSW

Commercially available system for nugget diameter measurements with 2D array ultrasonic transducer (52 elements)

No published work has been found regarding measurements on “real” spot welds, only calibration sample



[Spot Weld Analysis With 2D Ultrasonic Arrays](#)

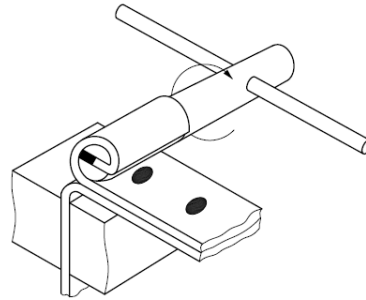
A. A. Denisov, C. M. Shakarji, B. B. Lawford, R. Gr. Maev, J. M. Paille
J Res Natl Inst Stand Technol. 2004 Mar-Apr; 109(2): 233–244. Published online 2004
Apr 1. doi: 10.6028/jres.109.015

Method – Peeling test

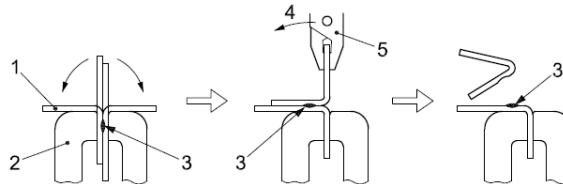
Quick method for measuring the diameter of the nugget.
Typically used in the industry for quality control (destructively)

However,

- Low repeatability
- Operator dependent
- Error approx. to +/- 0.5 mm



a) Example of peel testing using a vice and a roller



Method – Signal processing

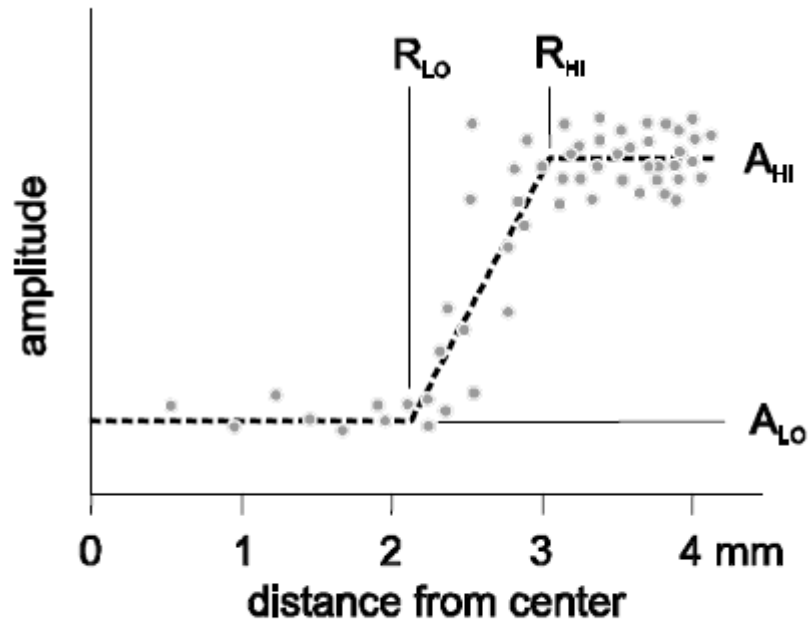
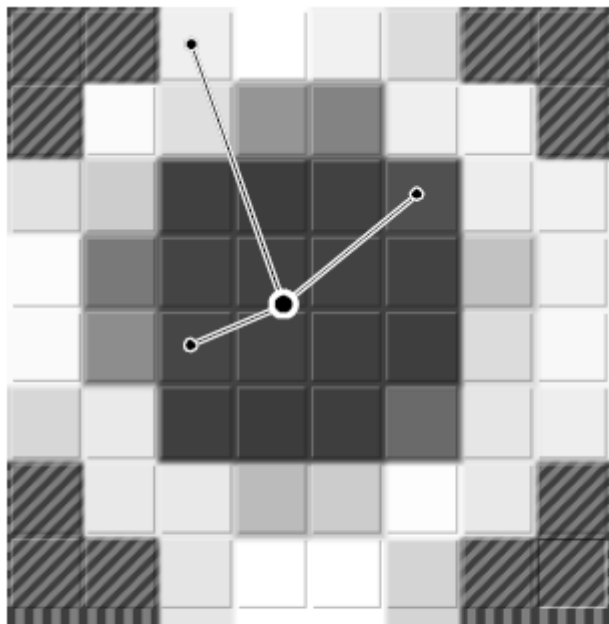
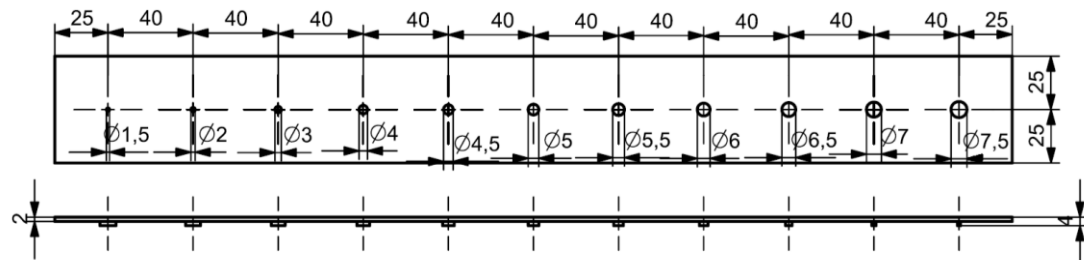
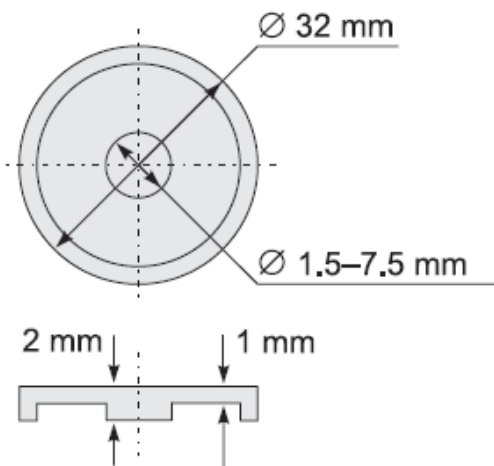


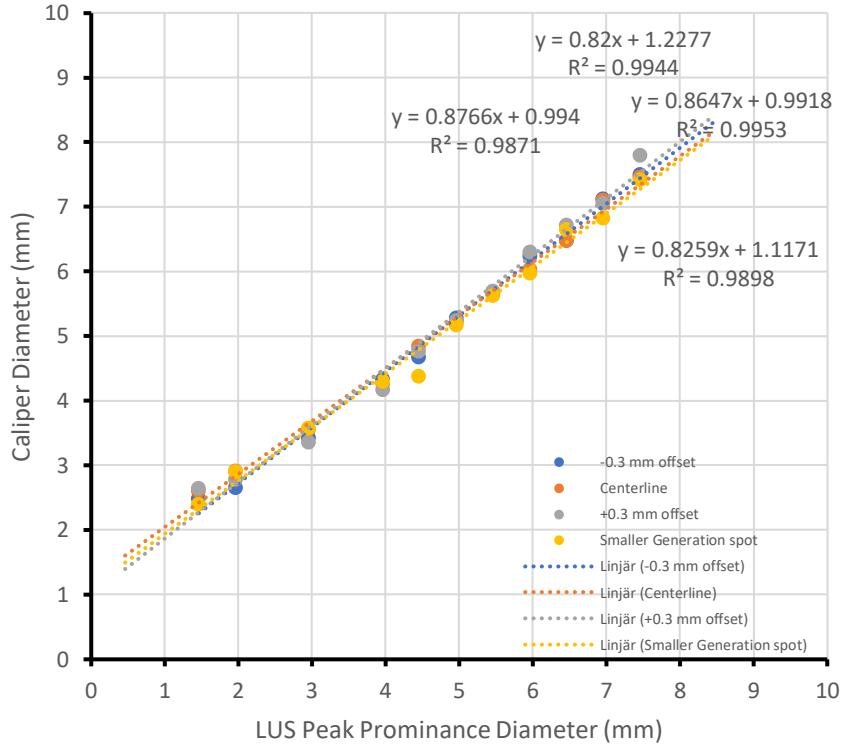
Figure 5. Building the image of the welded area

Method - Calibration sample

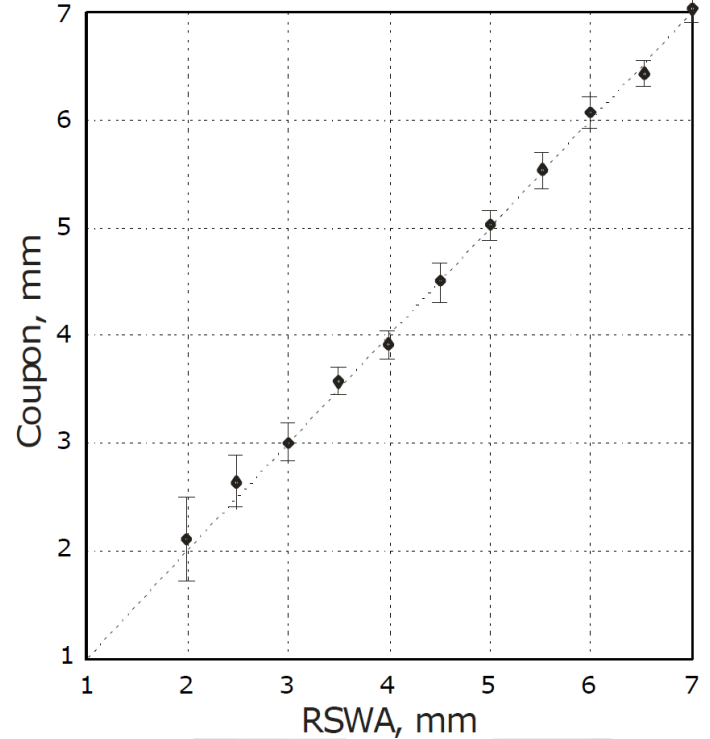


Results - Calibration sample

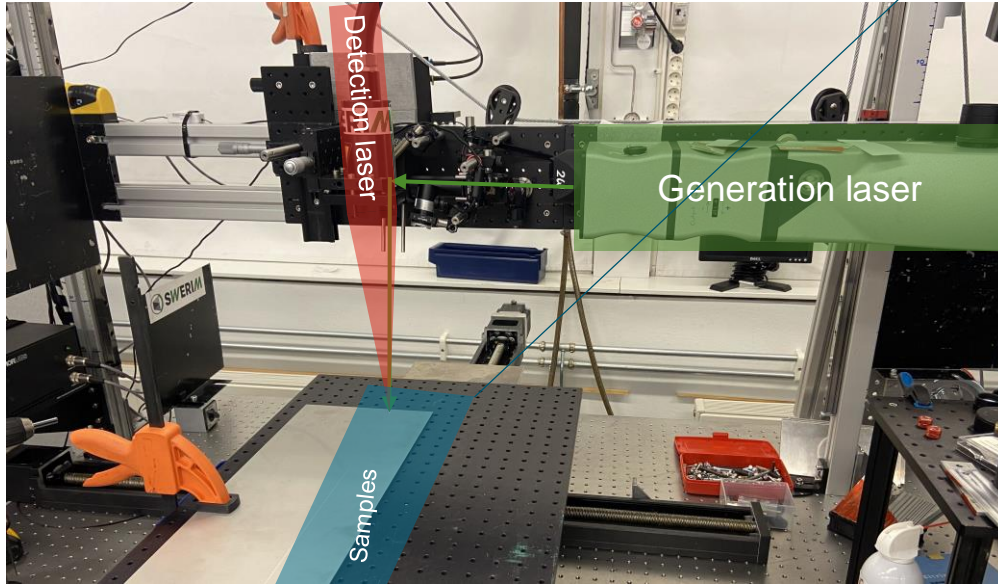
LUS – 1 dimension



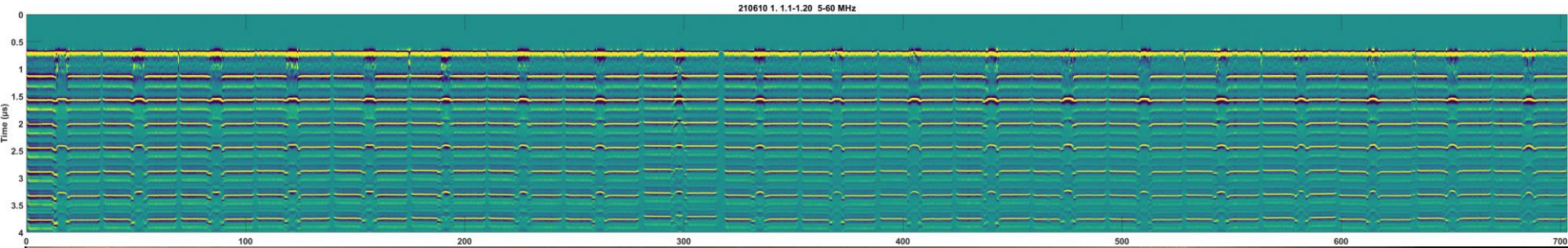
Tessonic UT (from paper)

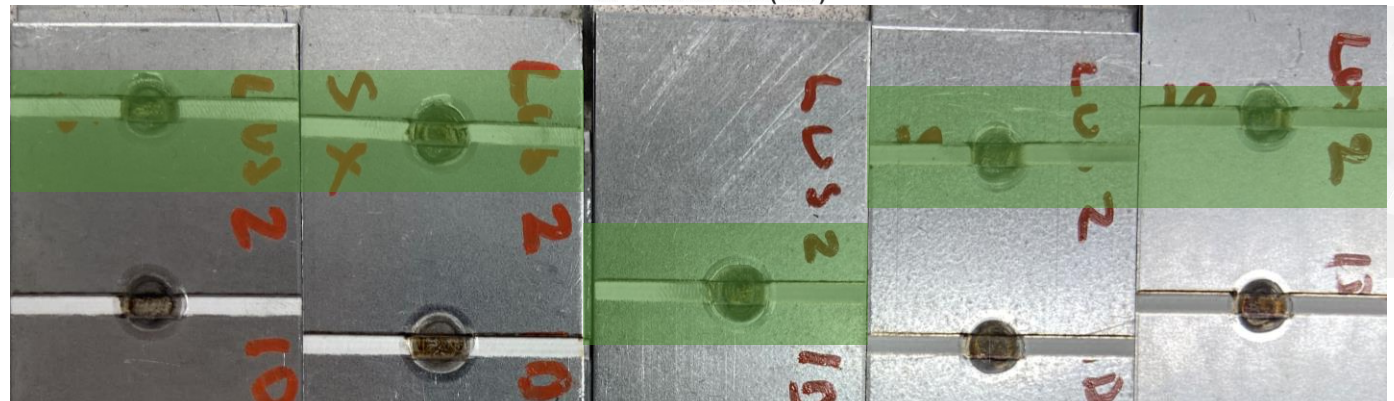
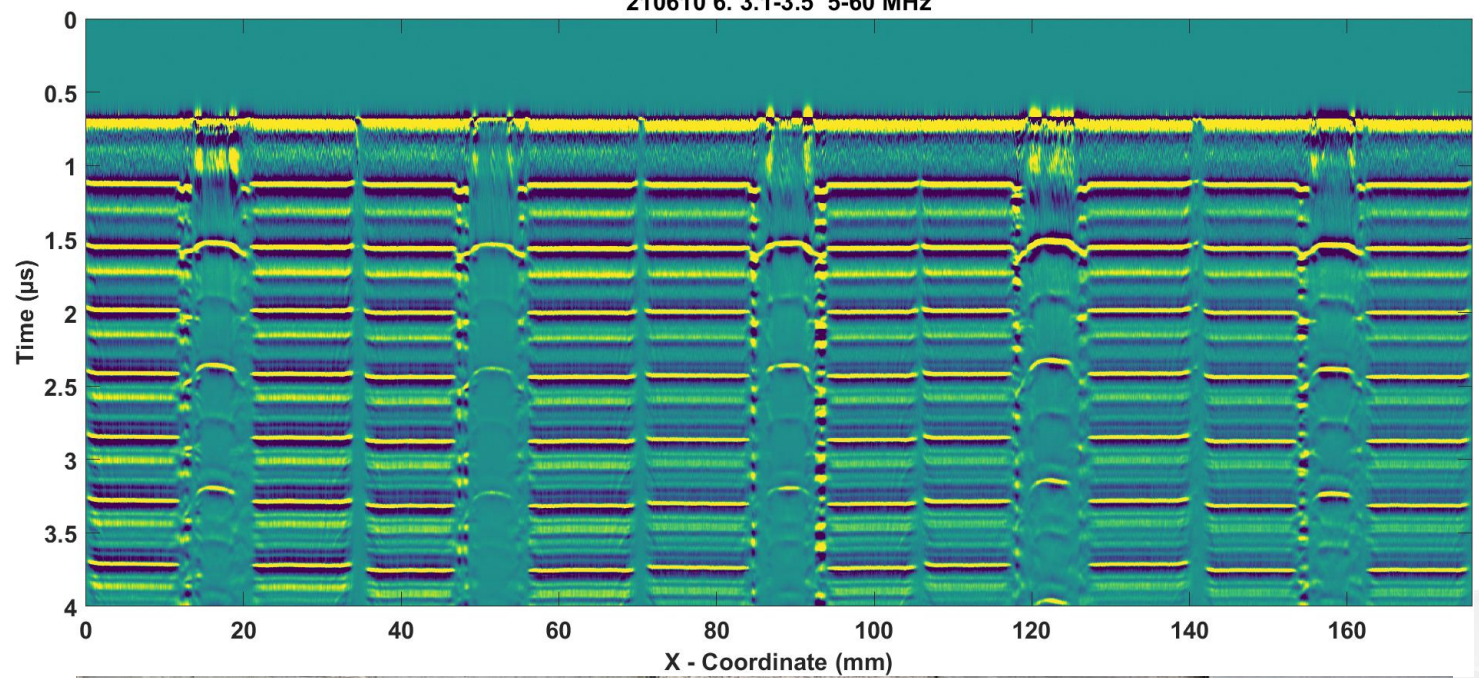


Method - LUS Setup



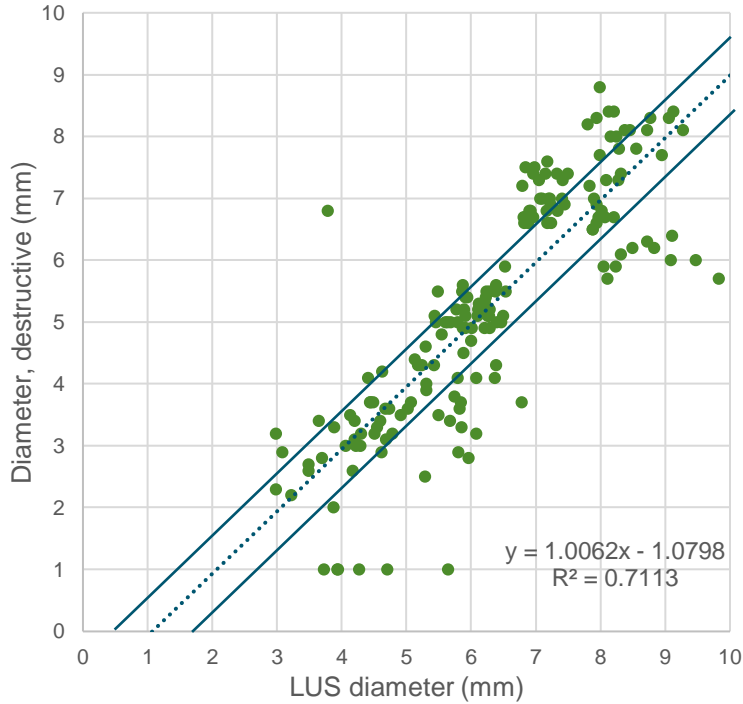
LUS results



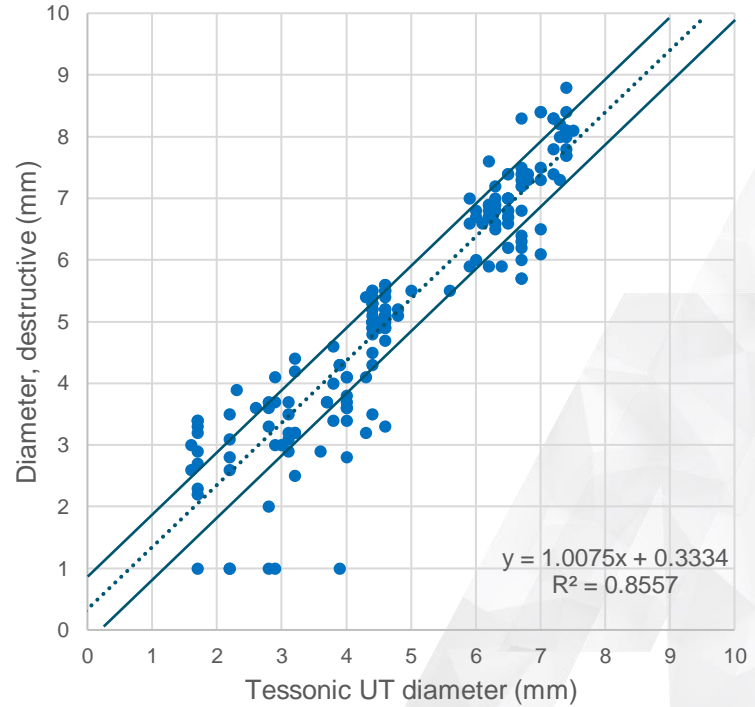


Comparison LUS & Tessonnic UT

LUS – 1 dimension



Tessonnic UT – 2 dimensions



Conclusions

- The results from the calibration block measurements clearly shows that LUS can measure spotweld diameter as accurate as the commercially available Tessonnic UT.
- The results from the spotweld samples shows that LUS is almost as accurate as the Tessonnic UT,
 - LUS was only employed in 1D whereas Tessonics UT is measures in 2D.
 - To increase the sensitivity and accuracy of the measurements, more research and investigations are needed.

However, since both LUS and Tessonnic are ultrasonic techniques, it is not expected that their detection limits and accuracies should differ in any significant way. The techniques should instead be evaluated by their applicability and usability. In other words, the driving force to implement LUS should not be focused on detectability and accuracy but rather its key advantages as a non-contact ultrasonic method.



SWERIM