

A new advanced portable phased-array system : the Mantis

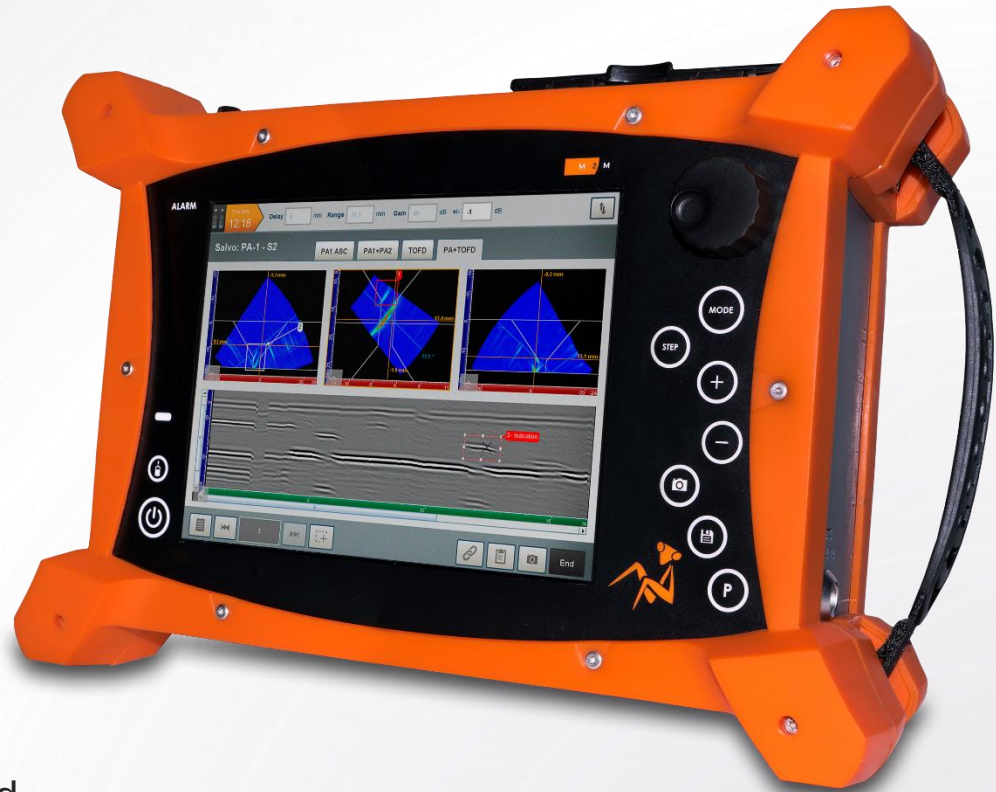


Phased-array technology

- Phased-array technology has been widely accepted in the industry as a powerful tool for the detection of corrosion and defects.
- Several standards now exist to specify the conditions of use of this technology
 - Non-destructive testing of welds — Ultrasonic testing — Use of automated phased array technology (ISO 13588:2012)
 - ASME Boiler & Pressure Vessel Code Section V Nondestructive Examination, Appendix IV and V
 - ...
- The use of phased-array can sometimes be seen as difficult and costly for companies in terms of training and potential turnover of their operators. It is thus important to have PA systems that are easy to use to minimize those cost

The Mantis

- A 16x64 PR phased-array system with standard UT and TOFD **included**
- Multigroup with **up to 8 groups** including one pair of TOFD simultaneously
- Up to **20kHz PRF** for fast corrosion mapping
- **Up to three axis encoder**
- **800% dynamic range** to capture saturated echoes



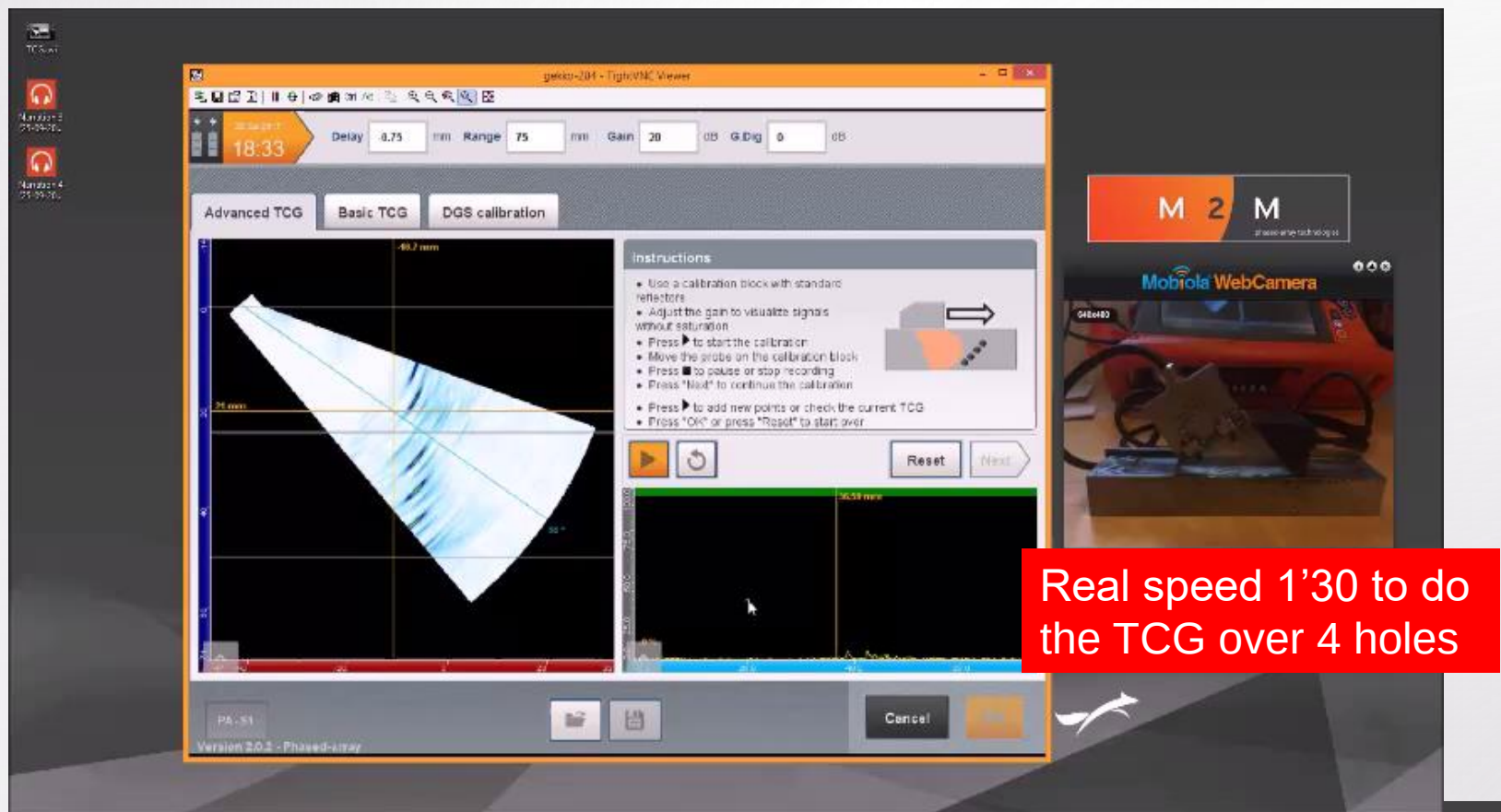
The Mantis

- Dedicated wizards for fast calibration to save time
- Fillet welds and nozzle applications to help understand
- Total Focusing Method included
- Analysis tools and reporting
- Connectivity: possible to remote control the Mantis from anywhere in the world



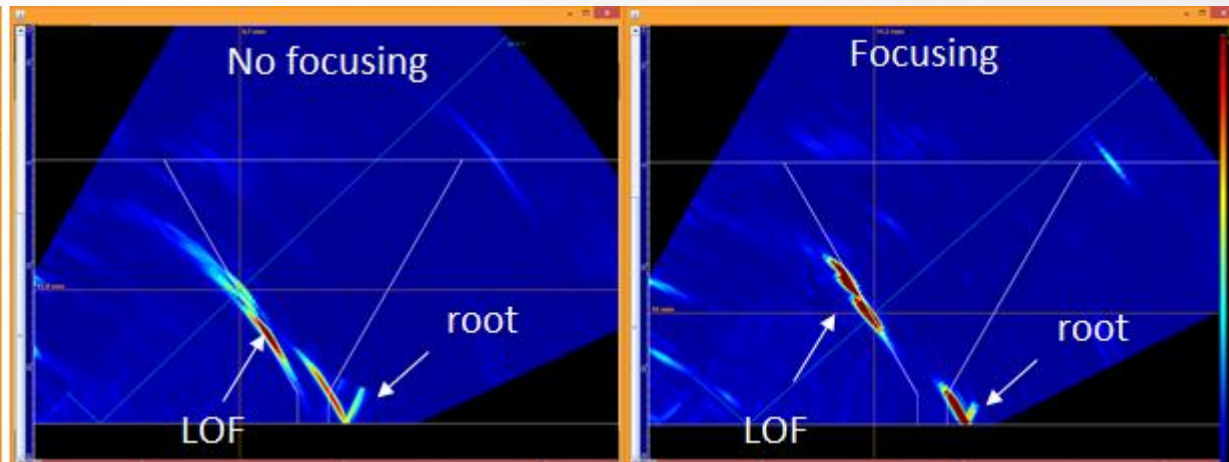
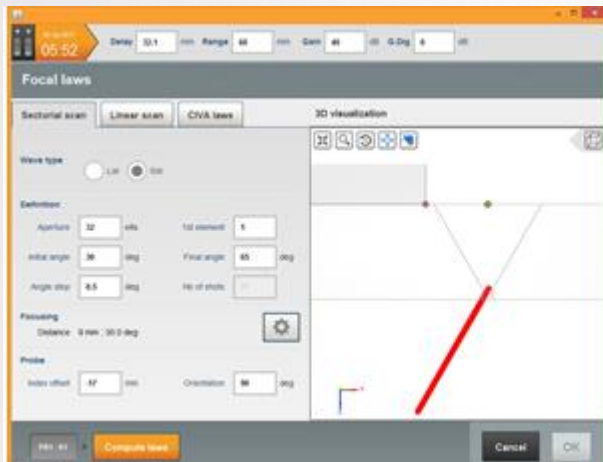
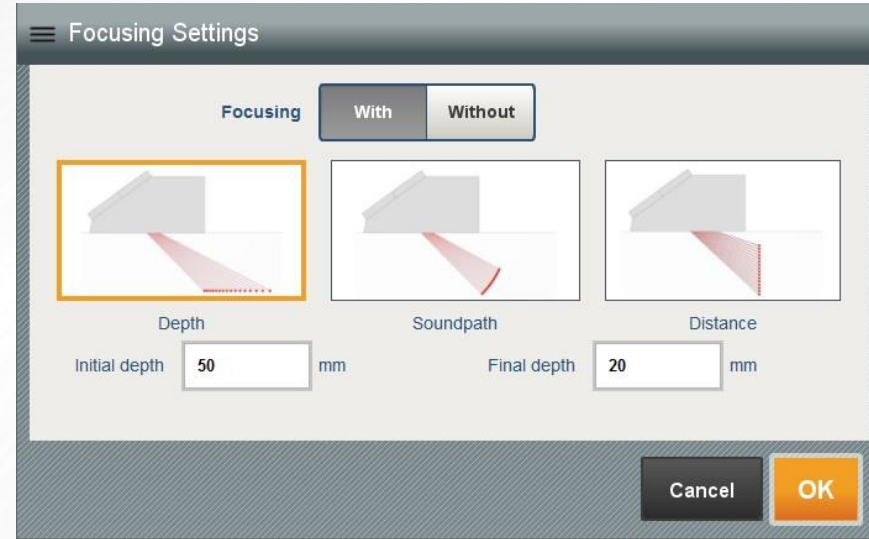
Example of Wizards – fast TCG

- The TCG on the Mantis can be performed really quickly saving times for operators
- The TCG can be saved and recalled later if using the same probe on the same material



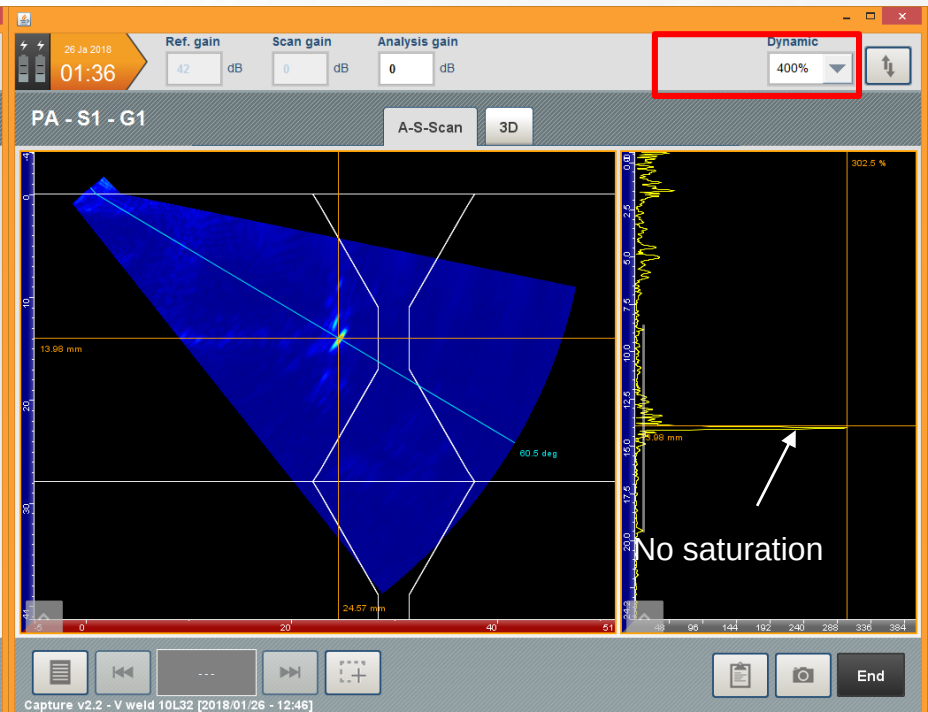
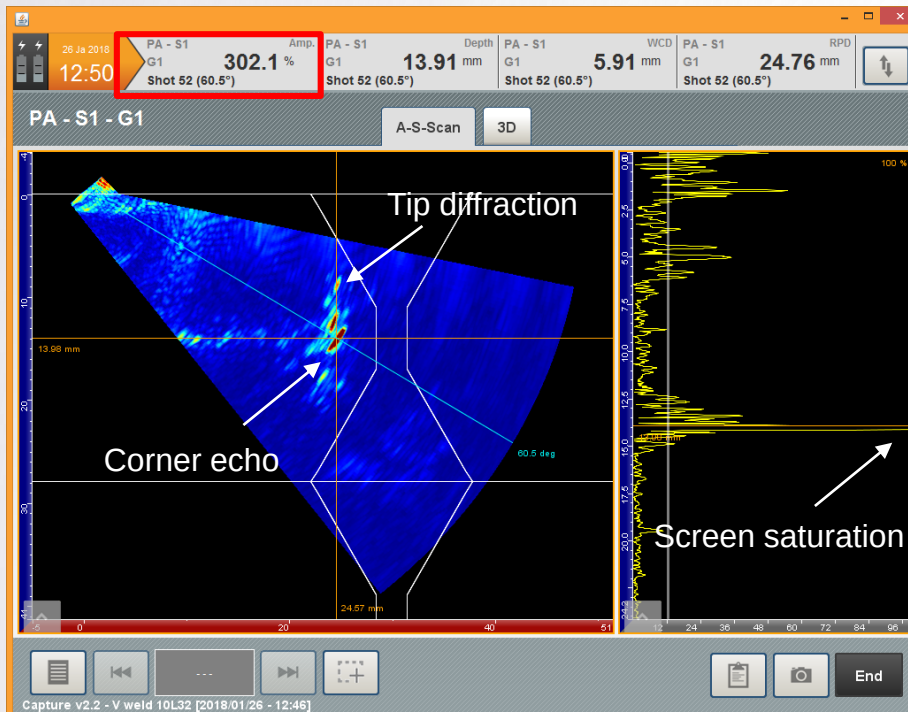
All delay laws calculated on board

- All the delay laws are calculated on-board even for dual-linear (DLA) or dual-matrix (DMA) arrays, **no need for an external software**
- Several focusing schemes are proposed, depth, constant soundpath or along a line like a chamfer



All 800% screen height

- The dynamic range of the Mantis is 16 bit meaning that echo can go up to 800% screen height without saturation
- In this example, the gain is set to have a tip echo at 80%, the corner echo amplitude is 302% so we have a screen saturation. By changing the dynamic to 400%, we see that the corner echo is not saturated and that it is possible to measure accurately the time of flight





Standard applications

Corrosion mapping

Acquisition at three different PRF: 6 kHz, 12 kHz and **20 kHz** (maximum for Mantis)



Corrosion Mapping
using compact
flaw detector MANTIS



Mantis

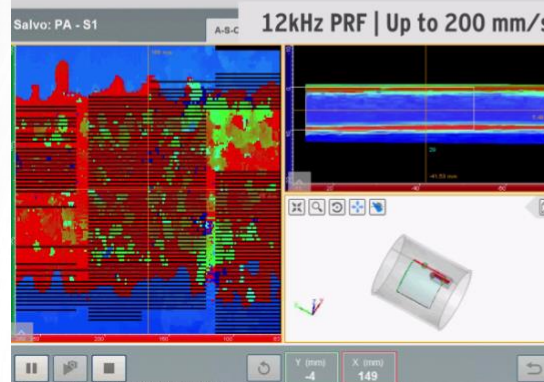
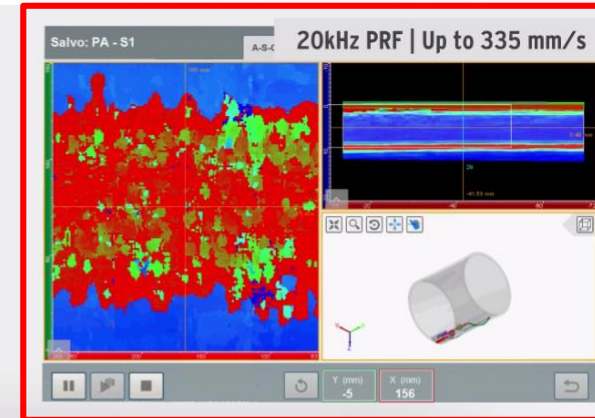
M 2 M

Corrosion mapping

- With a speed up to 20 kHz, the **Mantis can acquire data faster** without missing any frames
- With a dynamic range of 800% it is possible to saturate the backwall echo (over 100% screen height) to measure the first and second backwall and still measure precisely the sample thickness
- It improves productivity making it possible to map of lot of surface in a shorter amount of time



Maximum Mantis speed



Two phased-array + TOFD

- The Mantis can perform two phased-array probe + one pair of TOFD simultaneously
- Analysis and reporting can be done on board



**Weld inspection
using compact
flaw detector MANTIS**



Mantis

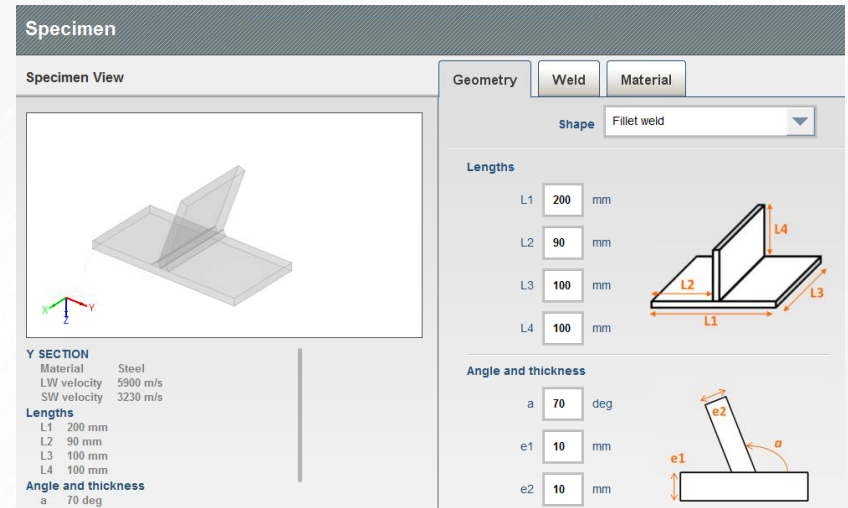
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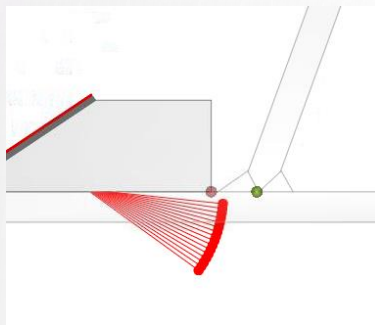
Dedicated applications

Fillet welds

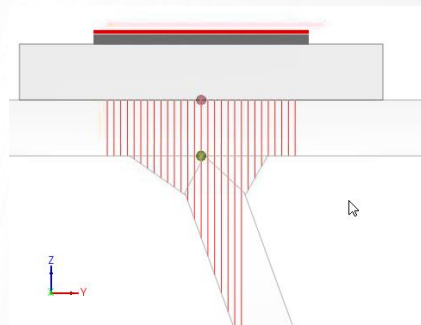
- M2M has developed a **unique fillet weld inspection application** that allows to define the fillet weld geometry (T and Y section) on the equipment and to display a cross-section superimposed with the ultrasonic data taking into account a full skip



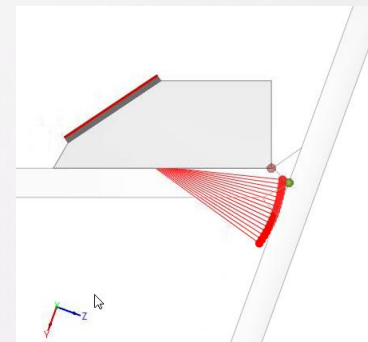
- The probe can be positioned on any surface of the weld and delay laws can be calculated directly on the equipment



flange



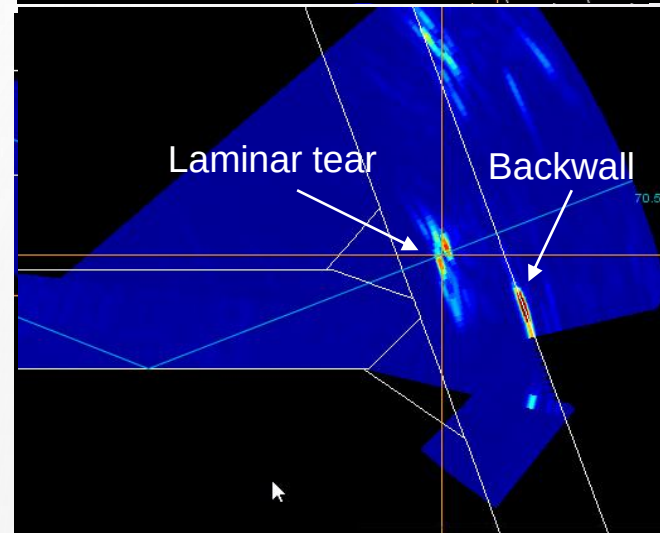
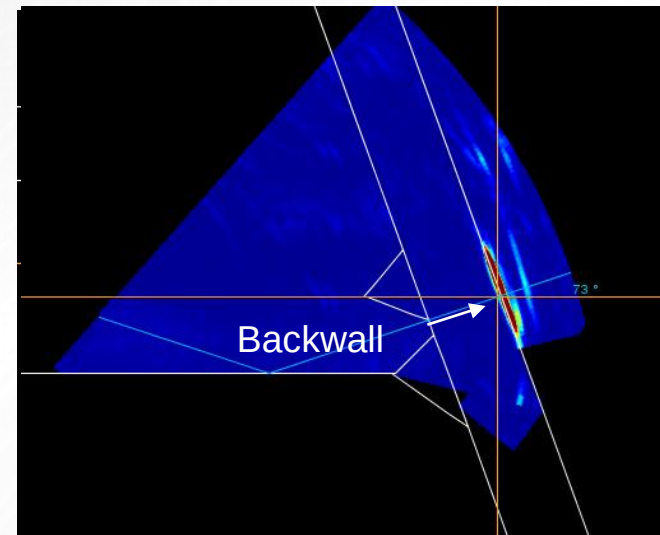
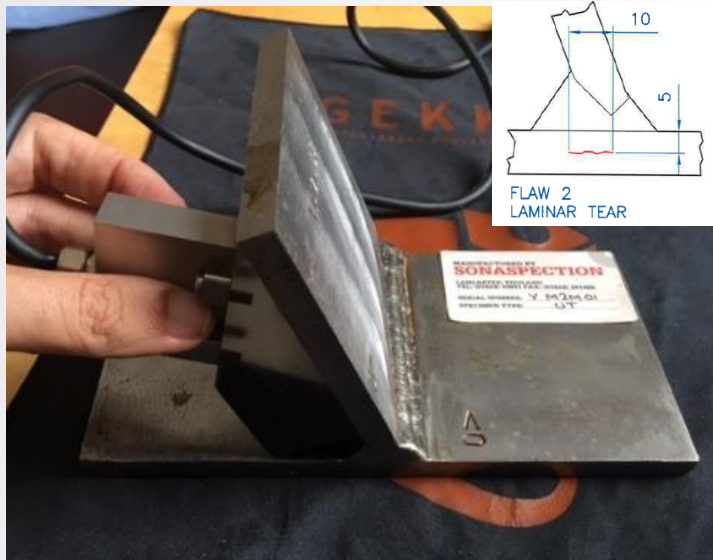
flange



Web plate

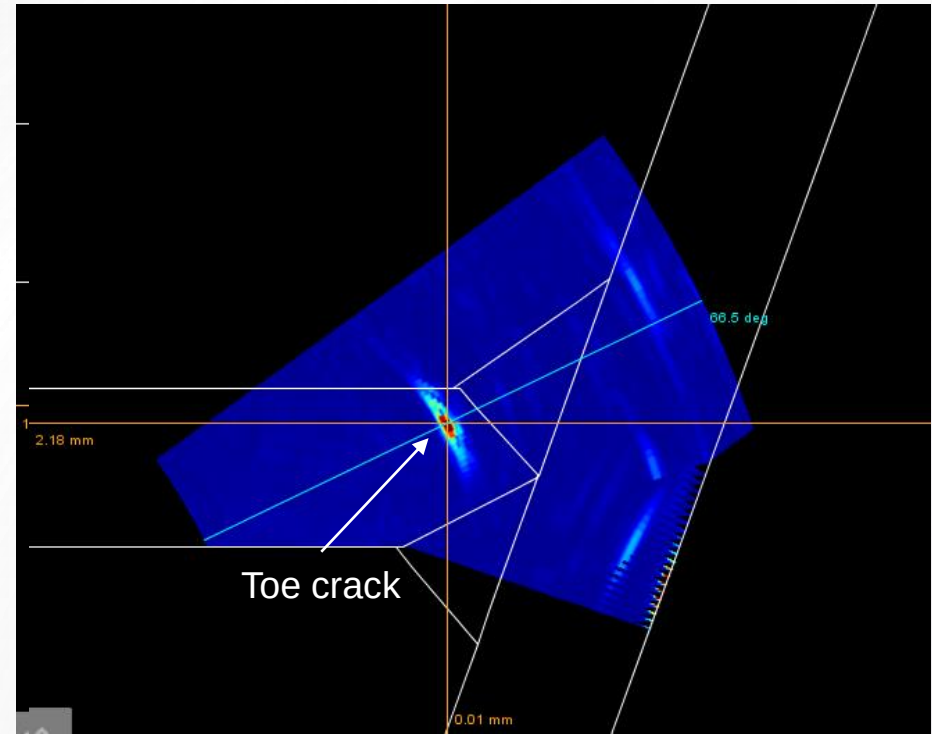
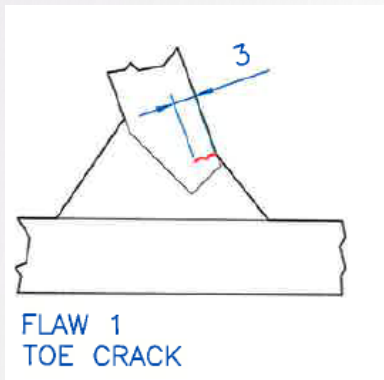
Fillet welds

- The Mantis can display the ultrasonic data in the CAD file of the component
- It can also represent the data after a skip making it easy to interpret indications



Fillet welds

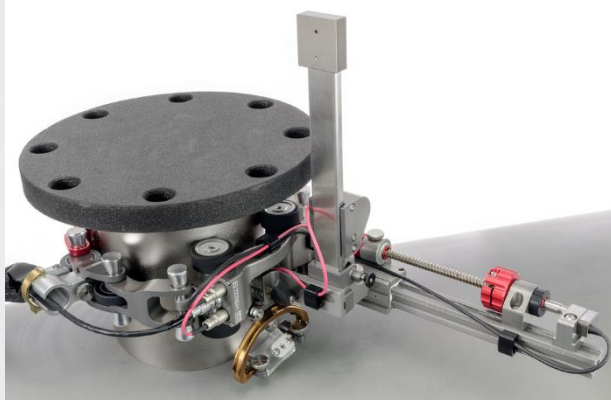
- The Mantis can display the ultrasonic data in the CAD file of the component
- It can also represent the data after a skip making it easy to interpret indications



Nozzles

M2M has developed a **unique nozzle inspection application** that allows to define a nozzle geometry and display in real-time a cross-section of the nozzle superimposed to sectorial or TFM data

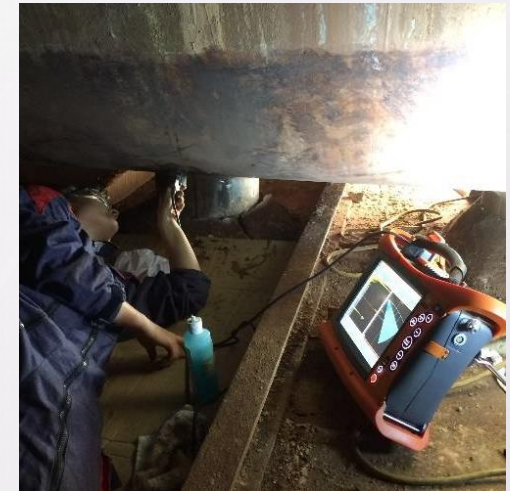
With up to three encoded axis, the Mantis (and Gekko) are the only systems that can use 3-axis nozzle scanners developed by vendors



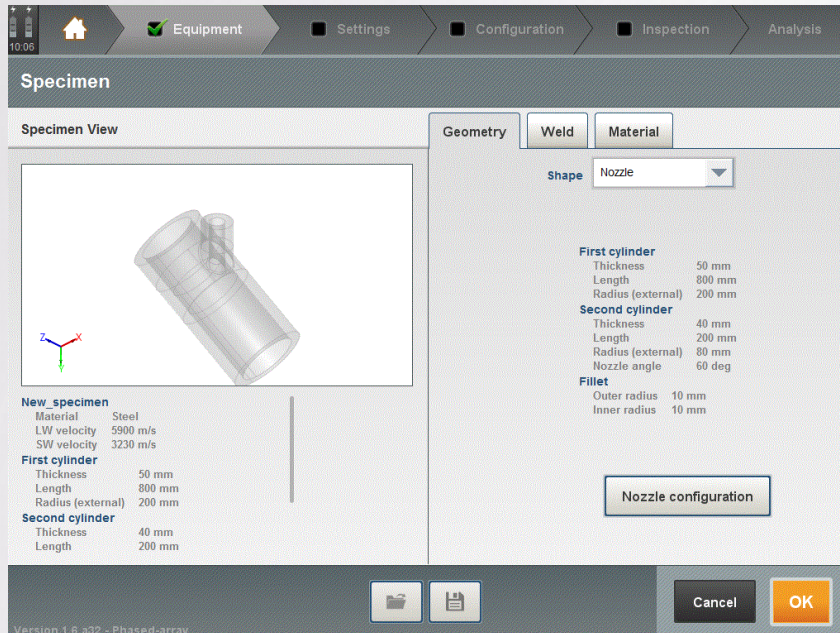
ROTIX - Nozzle Scanner from Jireh



Nozzlescan from Phoenix

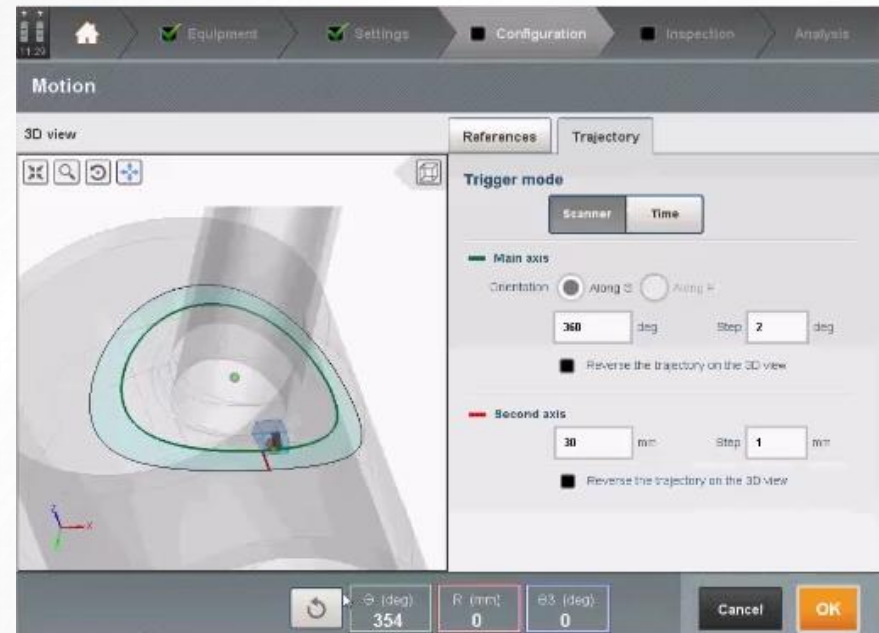


Nozzles



70° inlet/outlet

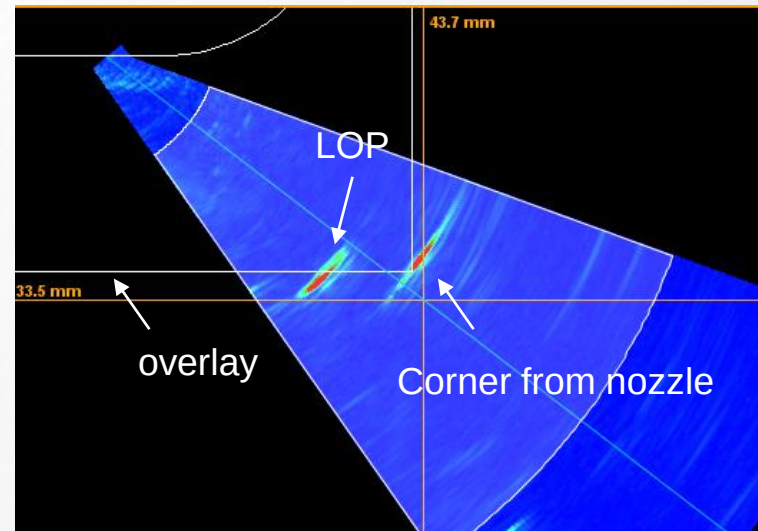
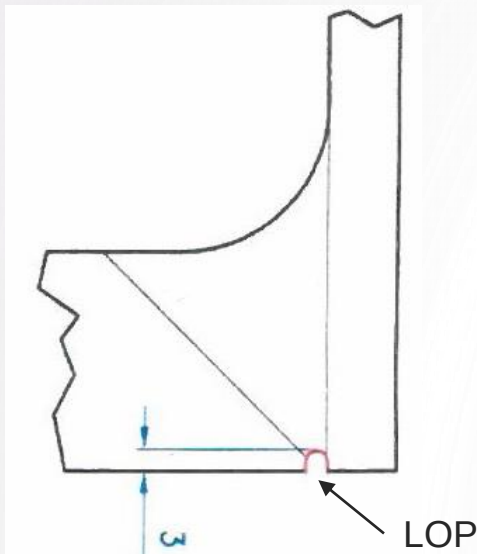
- Nozzles can be defined directly on the equipment by entering the parameters of the main pipe and nozzle
- Angled nozzle can also be defined



- Trajectory around or on the nozzle can be defined simply
- Manual inspection can also be done by simply entering the theoretical position of the probe

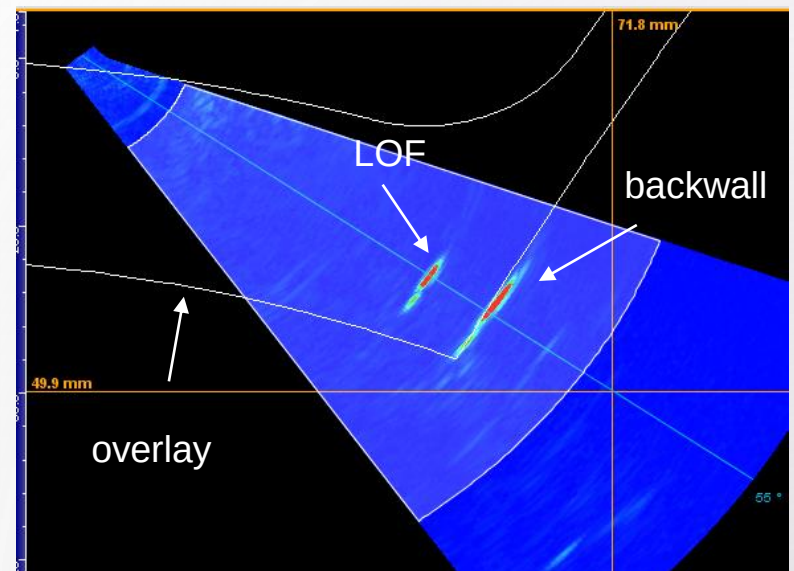
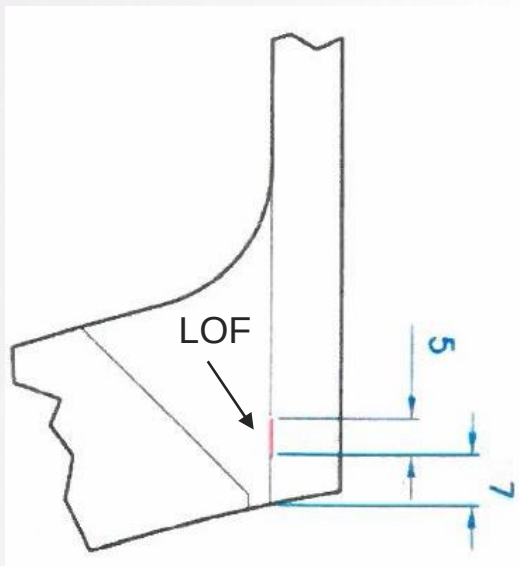
Nozzles

- Detection of a lack of penetration along the axis of the main pipe chamfers
- The corner from the nozzle is aligned with the overlay for the right positioning



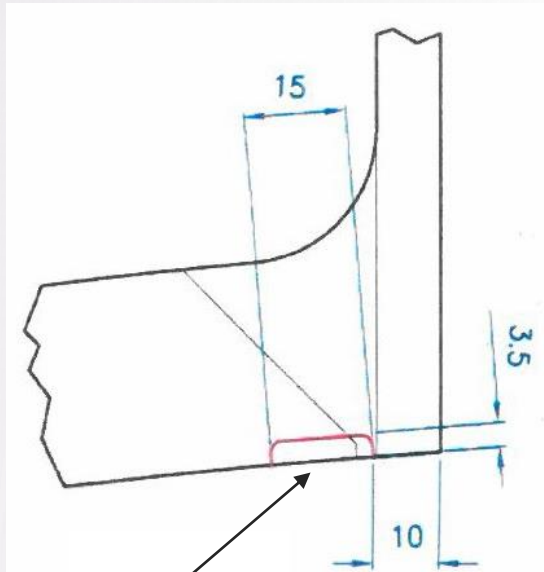
Nozzles

- Detection of a lack of fusion along one of the chamfers. The probe is at 45° around the nozzle
- The backwall echo from the nozzle is aligned with the overlay

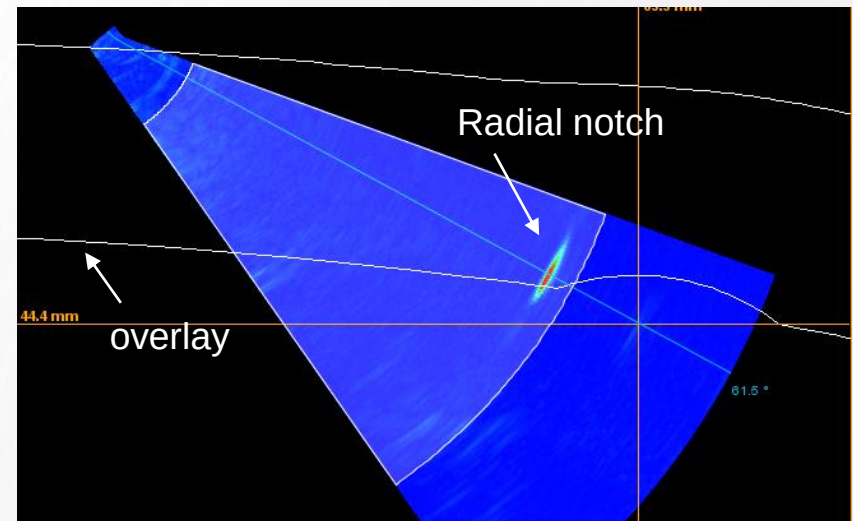


Nozzles

- Detection of a radial crack
- We use the third axis (skew) to steer the probe along a radial direction of the nozzle



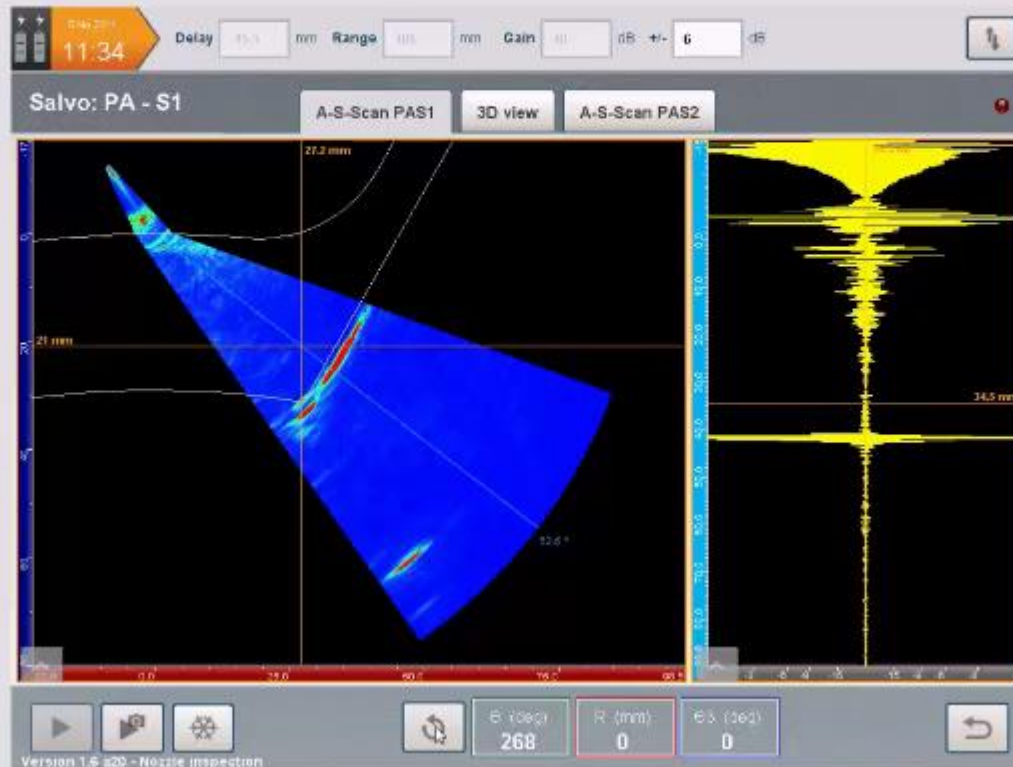
Radial notch



Nozzle

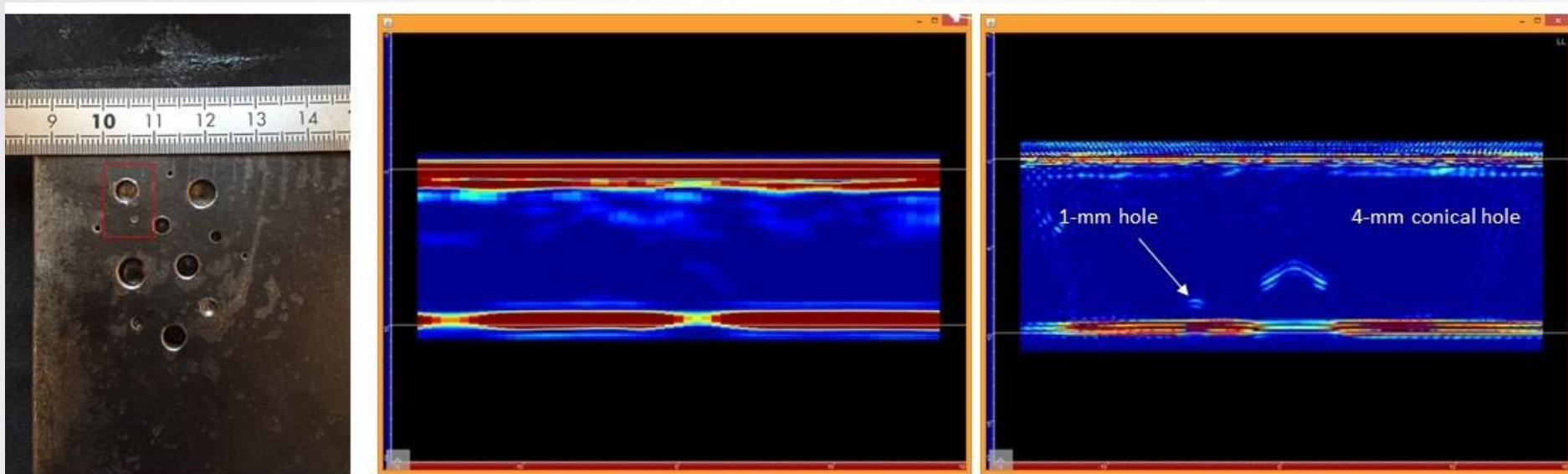
- The overlay of the nozzle is calculated in real time using the information for the three encoder inputs

Ready for real-time and explicit display of UT data



TFM – Total Focusing Method

- The Mantis has the TFM included in the standard package. It is limited to 16 elements but can be extended to 64 elements
- Here is an example that compares an electronic scan with a 64-element TFM over conical hole. The TFM shows a better dead zone and a better definition of the defects



Electronic scan

TFM

Conclusions

- M2M releases a new mid-range portable phased-array system, the Mantis
- It allows all the traditional phased-array and TOFD inspections
- Wizards allow for fast calibration of the equipment (specimen, probe, wedge, TCG...)
- Delay laws are all calculated on board even for complex DLA and DMA probes
- Specific applications have been developed for fillet welds and nozzles
- TFM is available on board making it the lightest portable system with real-time TFM