REAL TIME B-SCAN-ACQUISITION – A TOOL FOR HIGH SPEED AND HIGH SENSITIVITY INDUSTRIAL ON LINE INSPECTION

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Abstract: An application method of an array transducer is being introduced, where a high number of elements are simultaneously used for transmitting and receiving. There are many advantages of the acquisition of B-Scans in real time:

- Evaluation of a large area with one main bang
- High insensitivity to misalignments during testing
- High signal to noise ratio on a global evaluation level

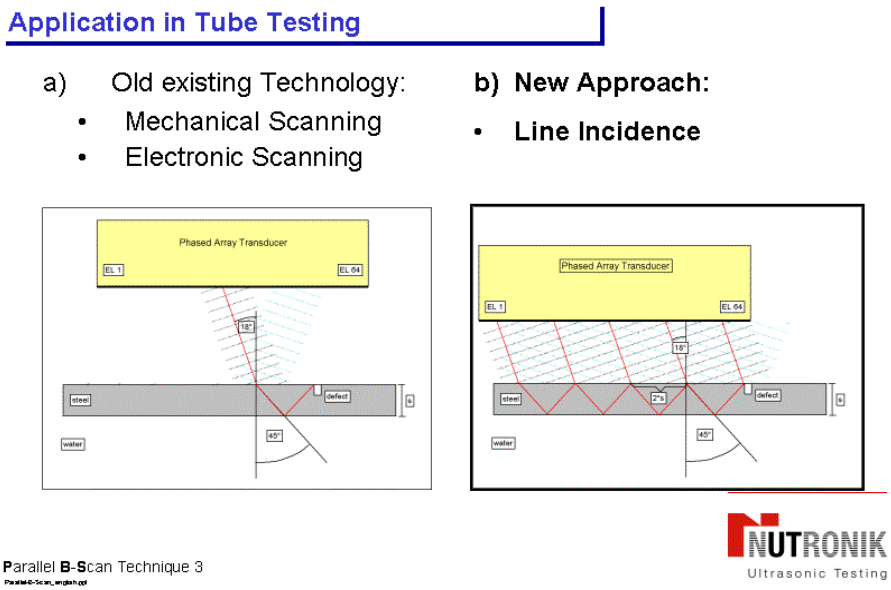
The application method is very versatile and can be adapted to a large variety of UT evaluation problems, offering high sensitivity at high throughput speeds. Application examples are presented in the field of weld and full body tube inspection as well as on bar and billet inspection.

Introduction: NUTRONIK has been engaged in NDE for more than 30 years. Coming from nuclear power plant parts testing, we are doing business in all qualities of tube and bar testing as well as in the non steel market of e.g. aircraft structures.

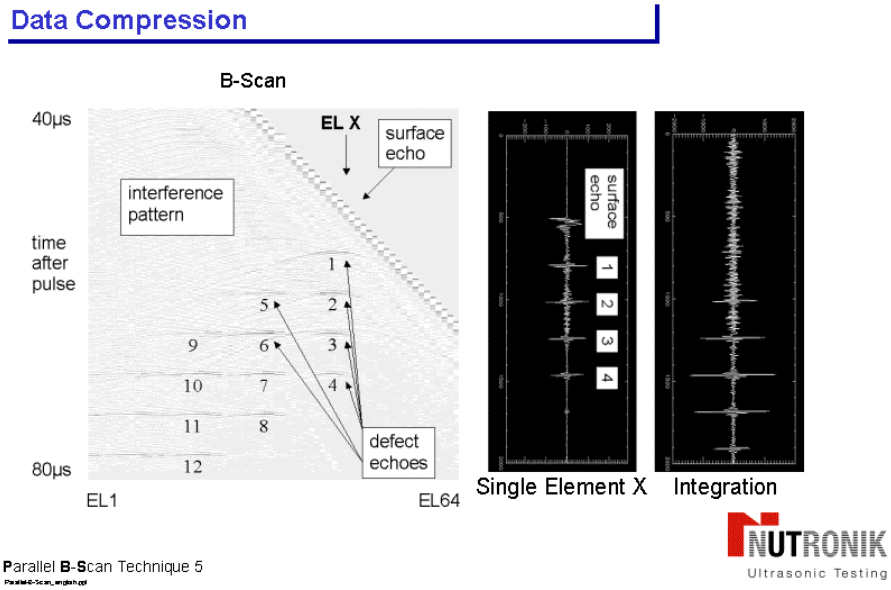
A main demand of today's customers is the increase of thru put combined with a higher sensitivity. On the other hand a higher probability of flaw detection must not result in an increase of false alarms.

The use of phased array technique is often synonymous with the replacement of a mechanical scan (and a conventional transducer) with an electronically scanned linear array transducer. Tube inspection systems applying this technique are known. However, due to the concentration of multiple incidence directions in one probe, many ultrasonic pulses need to be generated in a short period of time, which will result in cross talk problems. Those limitations may result in poor testing throughput. Today, in most tube or bar inspection systems based on the phased array technique, no high-speed test can be obtained. The main idea of our concept is the use of the phased array technique for tube inspection with a big aperture in one single shot. For a single surface flaw, the resulting B-Scan from shear wave incidence shows a pattern of multiple echoes. An appropriate algorithm can evaluate this pattern and reduces the amount of data.

(Slide 1: comparison to existing methodology)



(Slide 2: data reduction)

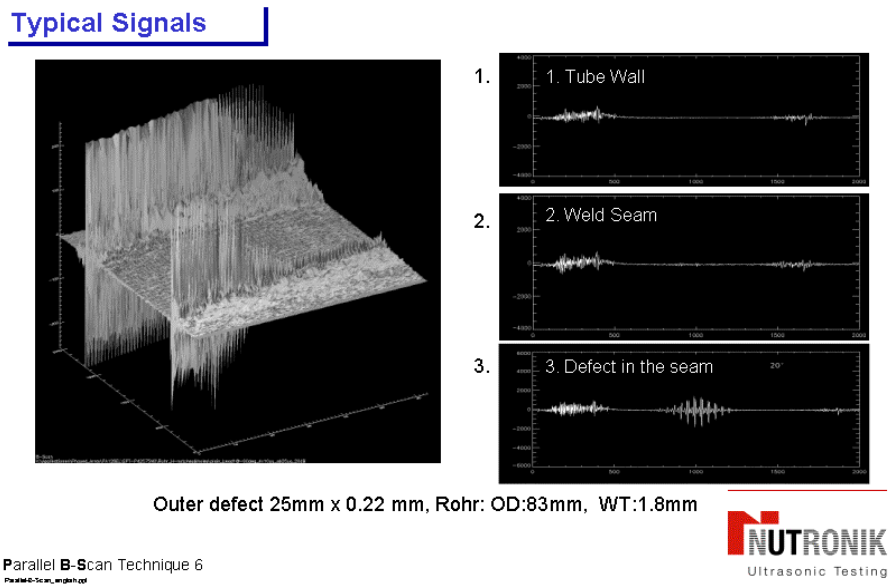


Slide 2 shows a resulting B-Scan. The signal to noise ratio of a single element A-Scan is shown in the left. On the right, all A-scans are summed up. While the returned flaw signal is enhanced, the entry echo is reduced due to the time shift in each element. Thus, signal to noise ratio is increased and the inspection over many skips is possible. As a result, the inspection of an entire tube segment can be evaluated in real time in one single shot (here: 32mm inspection range on a tube with OD=83mm).

Results: The following slides demonstrate the performance of this technique on a sample tube. In Slide 3 a B-Scan of a flawless tube wall is depicted, together with three computed A-Scans of

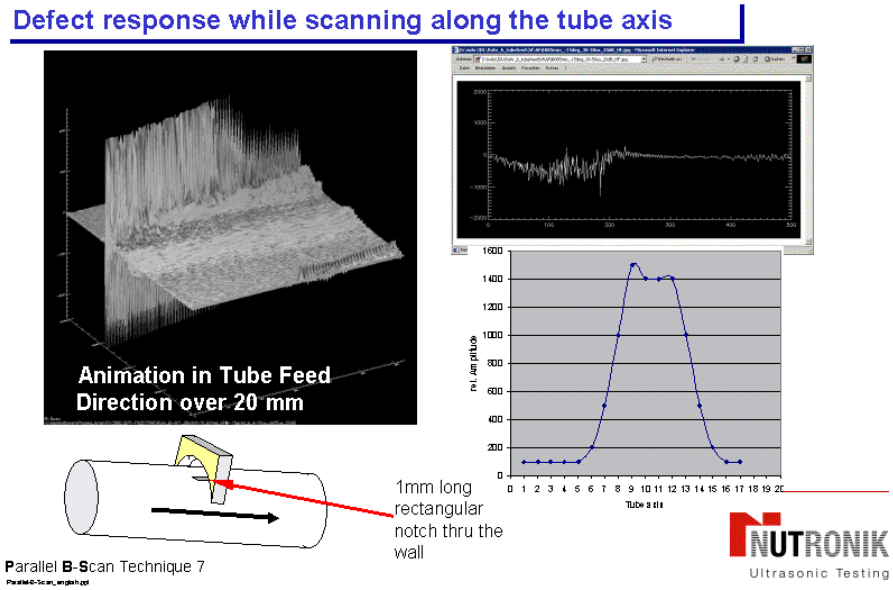
1. a flawless tube wall
2. a tube wall with bead seam (ERW-welded)
3. a tube wall with an outer defect

(Slide 3. typical results)



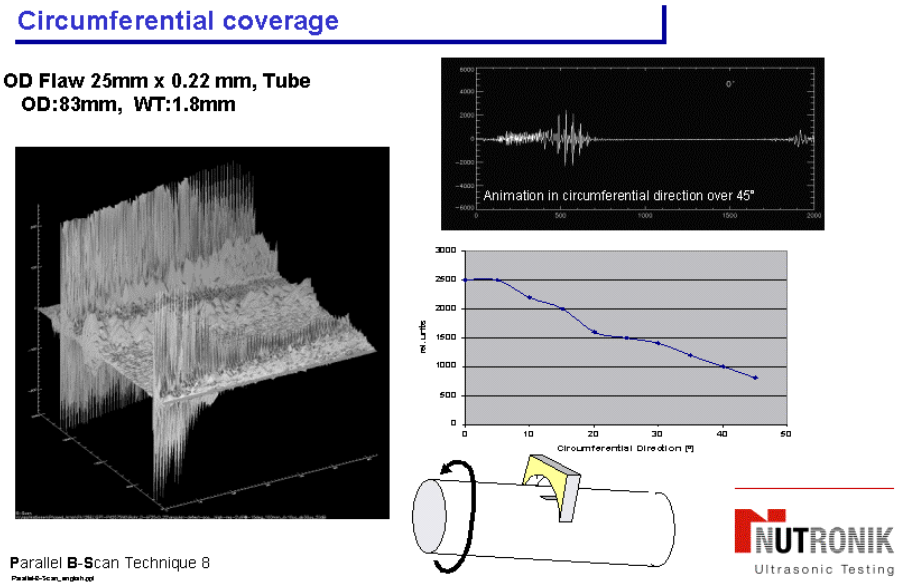
The next slide shows the detection response of a 1mm penetrating notch in the tube wall, while scanning across it in tube feed direction. This result shows the wide interaction profile over the tube axis.

(Slide 4: sensitivity along tube axis)



In slide 5, the circumferential coverage is displayed. It shows, that the signal can be detected over an angle range of about. 45 degrees, i.e. a single wide aperture pulse can substitute a high number of individual single pulses applying conventional methods. This reduction will result in an increased testing throughput.

(Slide 5: sensitivity in angular direction)



Discussion: The set up of such an inspection machine is totally different from UT-Systems with rotating transducers. Here, the transducer is mounted in a steady position, concentrically with respect to the tubes position. With this segment wise inspection technique, the throughput of such a system can be increased tremendously and still keeping a high sensitivity.

Conclusions: The newly introduced *real-time b-scan technique* improves the testing capabilities in both thru put and detection sensitivity.