GEKKO: Portable Phased Array Flaw Detector for High-Performance Defect Detection and High-Resolution Defect Characterization Using the Total Focusing Method (TFM)

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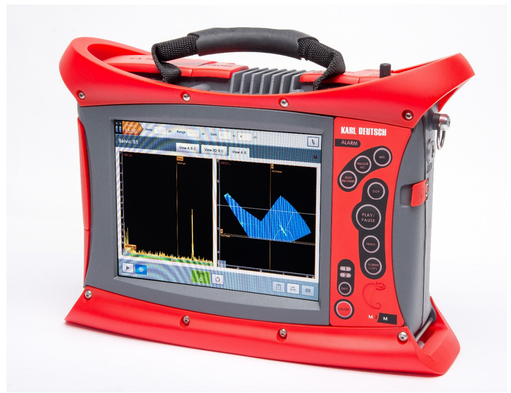
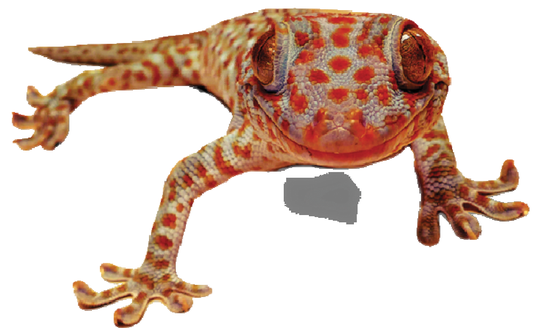
GEKKO: PHASED ARRAY FLAW DETECTOR

Features: 64 PAUT & 4 TOFD channels,
Bandwidth 0,5 to 20 MHz,
Sector scan, Electronic scan,
User-friendly and intuitive software



Highlights: Matrix array testing, Multi-Group test,
High resolution defect characterization,
Real-time Total Focusing Method (TFM),
Coming soon: Adaptive TFM
for curved or corroded components



TFM-Imaging: 256x256 pixels,
1 pixel = 1 focused point,
Imaging with 25 frames per second,
Sampling depth: 8000 points (time)

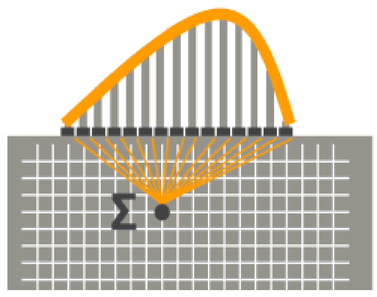
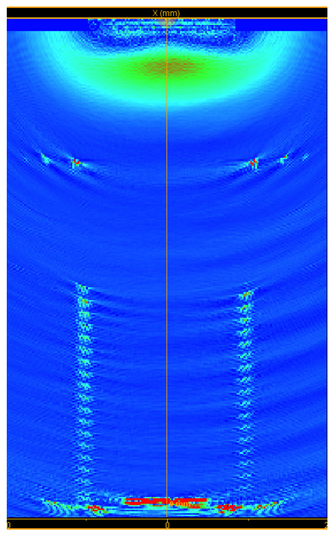


image of thread of screw



PRINCIPLE OF ULTRASONIC IMAGING

FMC + TFM = Full Matrix Capture + Total Focusing Method

FMC: Acquisition of complete set of A-scans of all T-R-signals of all elements
TFM: Same idea as in SAFT but applied to another data set

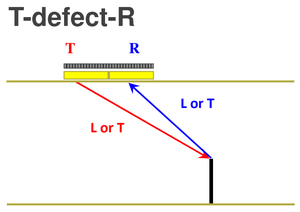
Main advantages of FMC + TFM:

Optimal focusing and spatial resolution everywhere. Direct imaging of large test volume from one probe position. Simultaneous evaluation of all test angles of the phased array probe. Possibility of 3D-imaging.

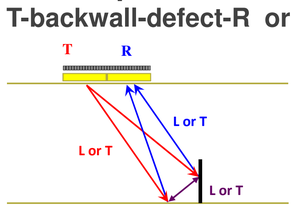
Multi-Mode TFM imaging:

In general crack-type defects are detected from different ultrasonic paths or “modes” (T = transmit, R = Receive):

Direct modes
T-defect-R



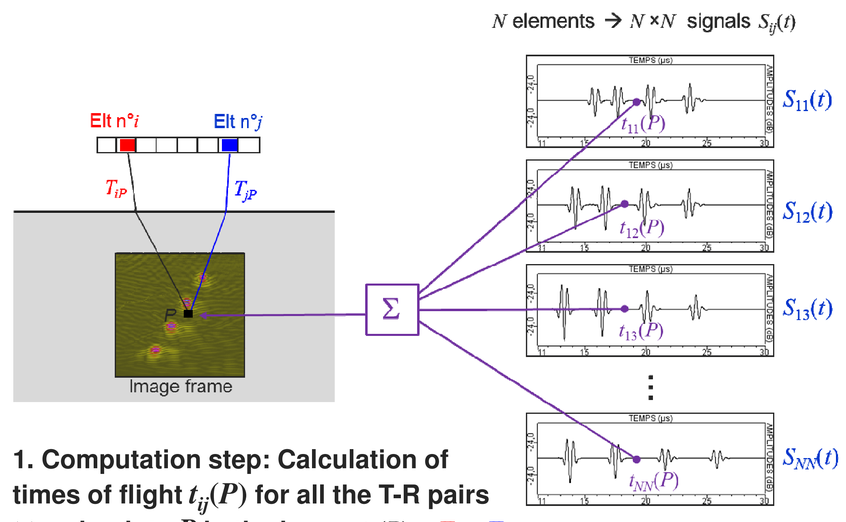
Half-skip modes
T-backwall-defect-R or T-defect-backwall-R



8 possible half-skip modes:
(L = Longitudinal, T = Transverse)
LLL, LLT, LTL, LTT
TLL, TLT, TTL, TTT

Total Focusing Method (TFM)

Key idea: To achieve coherent summation of defect echoes in order to maximize amplitudes in accordance with defect positions.



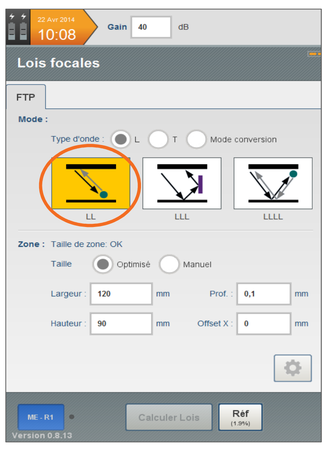
1. Computation step: Calculation of times of flight $t_{ij}(P)$ for all the T-R pairs i,j and points P in the image $t_{ij}(P) = T_{iP} + T_{jP}$

2. Summation step: Summation of NxN amplitudes $s_{ij}[t = t_{ij}(P)]$

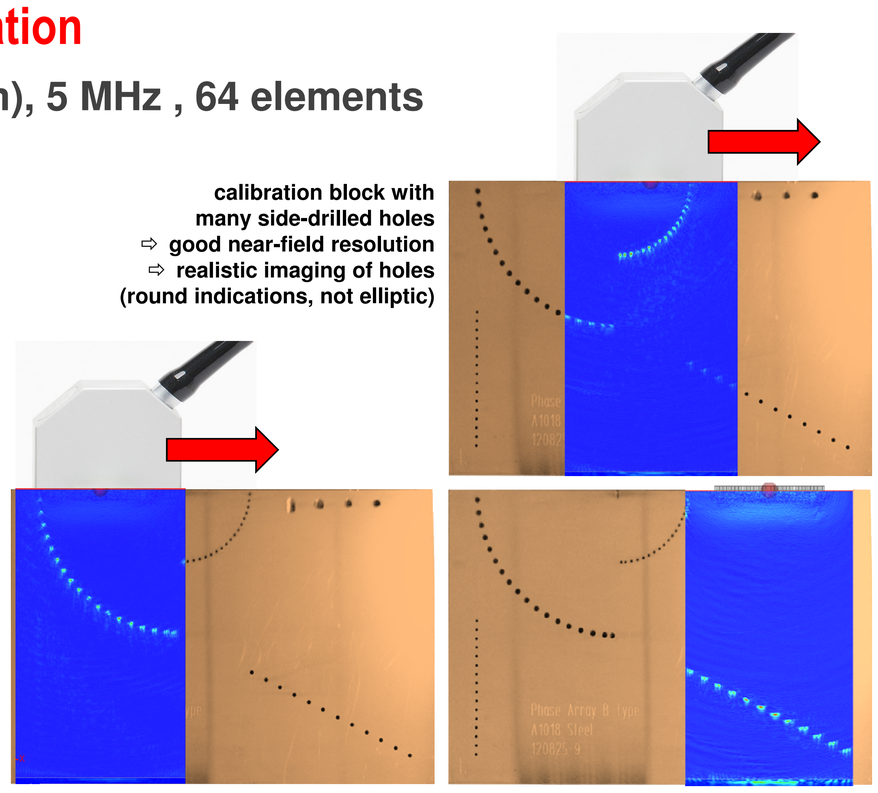
TFM-APPLICATIONS

Direct Insonification

LL (straight beam), 5 MHz , 64 elements

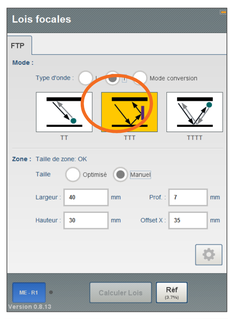


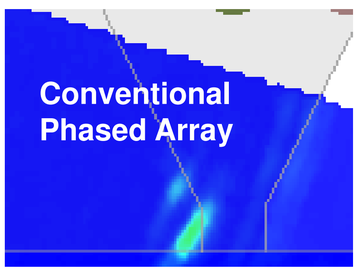
calibration block with many side-drilled holes
⇨ good near-field resolution
⇨ realistic imaging of holes (round indications, not elliptic)

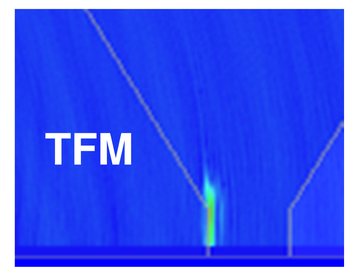


Weld Testing (Half Skip)

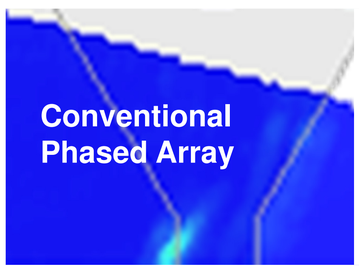
TTT (angle beam), 5 MHz, 64 elements

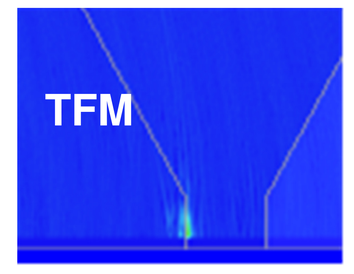






5 mm-vertical notch in weld root ⇨ only well-shown with TFM

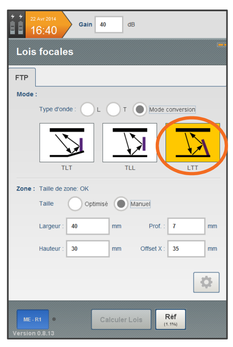


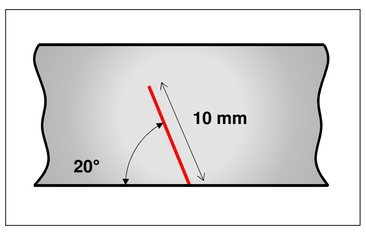


2 mm-vertical notch in weld root ⇨ only well-shown with TFM

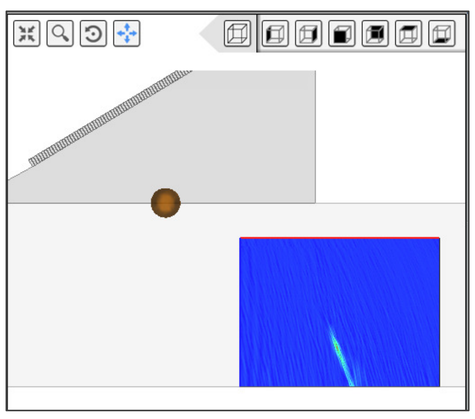
Mode conversion

LTT (angle beam),
5 MHz, 64 elements



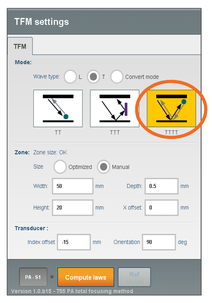


oblique notch (10 mm)
⇨ perfect defect image with TFM

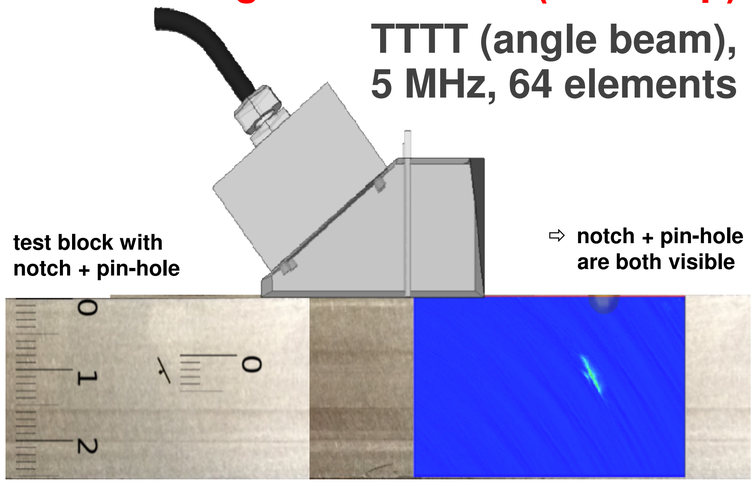


Angle Beam Test (Full Skip)

TTTT (angle beam),
5 MHz, 64 elements



test block with notch + pin-hole



⇨ notch + pin-hole are both visible

M 2 M
phased-array technologies

KARL DEUTSCH