New Customizable Phased Array UT Instrument Opens Door for Furthering Research and Better Industrial Implementation

INTRODUCTION

Phased Array UT as an inspection technique in itself continues to gain wide acceptance. However, there is much room for improvement in terms of implementation of phased array (PA) technology for every unique NDT application across several industries (e.g. oil and petroleum, nuclear and power generation, steel manufacturing. etc.). Having full control of the phased array instrument and customizing a software solution is needed for more seamless and efficient inspections, from setting the PA parameters, collecting data, reporting, and the final analysis. NDT researchers and Academics also need a flexible and open platform to be able to control various aspects of the phased array process. A high performance instrument with advanced PA features, faster data rates, a smaller form factor, and capability to adapt to specific applications will be discussed.

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PROBLEM

- Closed hardware/software can be difficult for research where flexibility is needed
- Advanced Phased Array systems are typically larger in form factor posing several integration challenges
- Advanced Phased Array systems are often seen as "too expensive"
- Overly complex software can be challenging for operators
- Historically challenging inspections are due to limitations in scanner and software offerings

SOLUTION

- Customizable and Open Software Platform
  - Software Development Kit
  - Access all Phased Array parameters
  - Acquisition Data
    - (A-scan, HW Gate Results, Encoders, I/O State)
- Smaller form factor
- Fast Data Rate
- Information about the hardware to integrate more seamlessly
- Cost effective instrument without compromising on advanced features and quality

ADVANCED PHASED ARRAY FEATURES

- 140V Negative Square Pulse (width 30-1000ns)
- Up to 20kHz PRF
- Dynamic Depth Focusing (DDF)
- Distance Amplitude Correction (DAC)
- 5ns Delay Resolution, 40us Delay Range
- 4 Gates with Interface Echo Tracking
- FIR & IIR Filters. Can set different filter per cycle
- RF, FW, Neg Rectified, Pos Rectified, Smoothing
- 100 MHz A-scan Sampling
- A-scan Length = 16,000 Bytes
- Temp sensor on each bard for monitoring
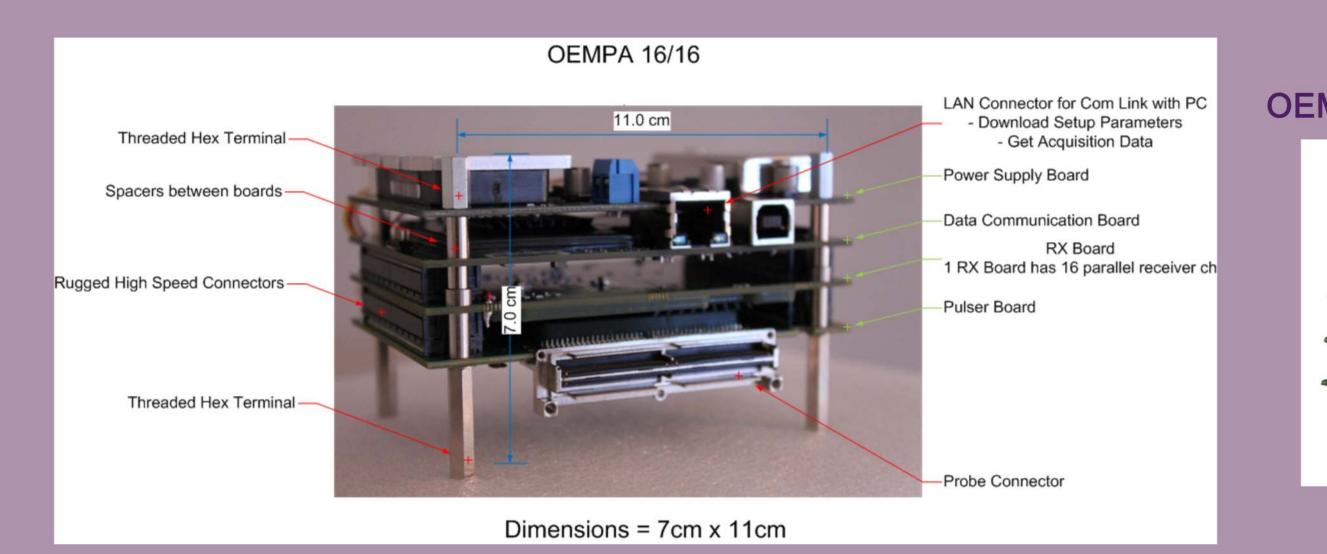- ... and More!!

-60° to 60° S-Scan with DDF
1mm SDH, 5mm vertical spacing

SCALABLE HARDWARE

OEMPA 16/16

Threaded Hex Terminal
Spacers between boards
Rugged High Speed Connectors
Threaded Hex Terminal

LAN Connector for Com Link with PC
- Download Setup Parameters
- Get Acquisition Data
Power Supply Board
Data Communication Board
RX Board
1 RX Board has 16 parallel receiver ch
Pulser Board
Probe Connector

Dimensions = 7cm x 11cm

OEMMC: Multichannel UT (8 to 40CH)

OEMPA 64/64

Add 3 more Rx boards to get 64/64

APPLICATIONS

Example Applications that Benefit from Smaller Form Factor:
- Subsea Inspections
- In-reactor repair weld
- Riser (recertification inspection)
- Pipeline Girth Weld

Subsea Non-Destructive Testing of Mooring Chain Links
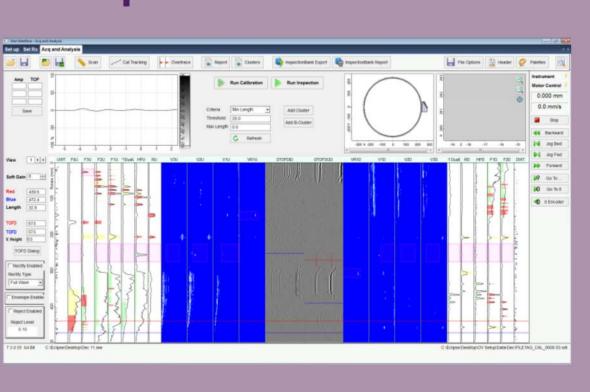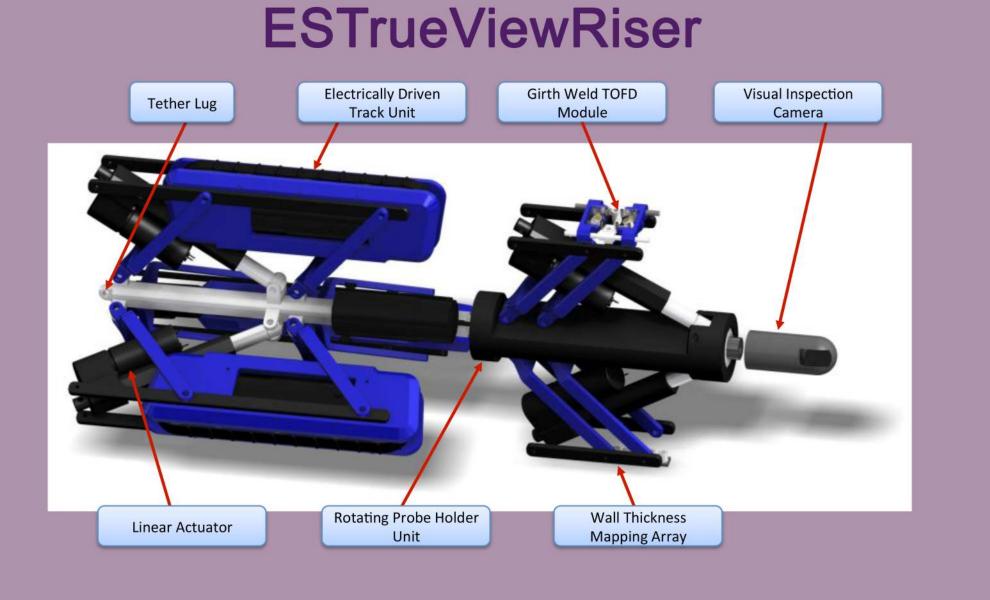

Localized NDT performed during weld process

Sealed system at repair location in-reactor
(mock-up trials shown — ECA for first inspection, followed by volumetric phased array wheel probe)

Subsea ROV

ESTrueViewRiser

ESTrueViewPipe

Weight and size is always a concern – new instrumentation is allowing significant size and weight reduction – enabling a return to localized pulse source on mechanical rig.

SMALL FORM FACTOR

- Decreasing the size of the instrument opens doors for several improvements in industrial implementation of Phased Array
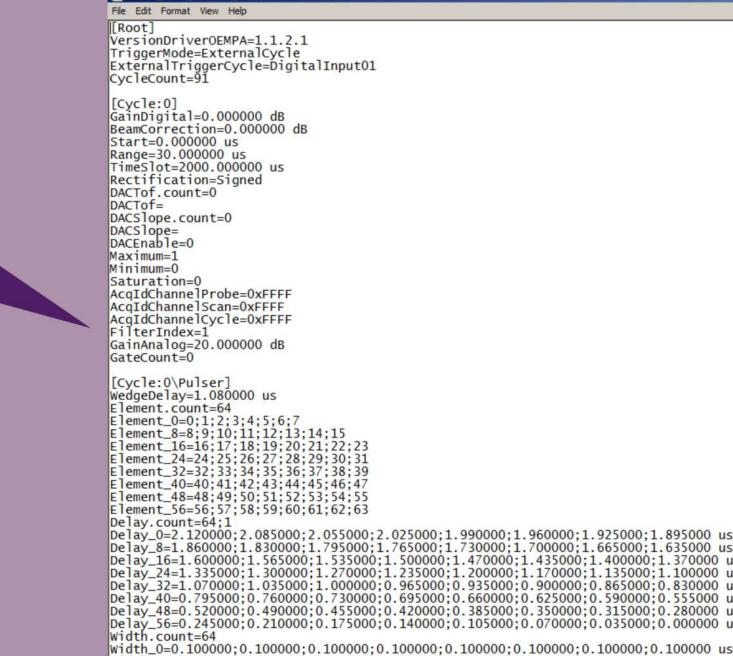 - Integration is easier because you are free to place the instrument in locations that are normally not possible.
    - Mount the PA unit on a scanner to shorten the transducer cable
      - Benefits:
        - ≫ Save cost on expensive cabling
        - ≫ Field operators don't have to deal with heavy and cumbersome cables that can get caught in scaffolding or structures
    - Mount the PA unit inside an underwater ROV for subsea inspections
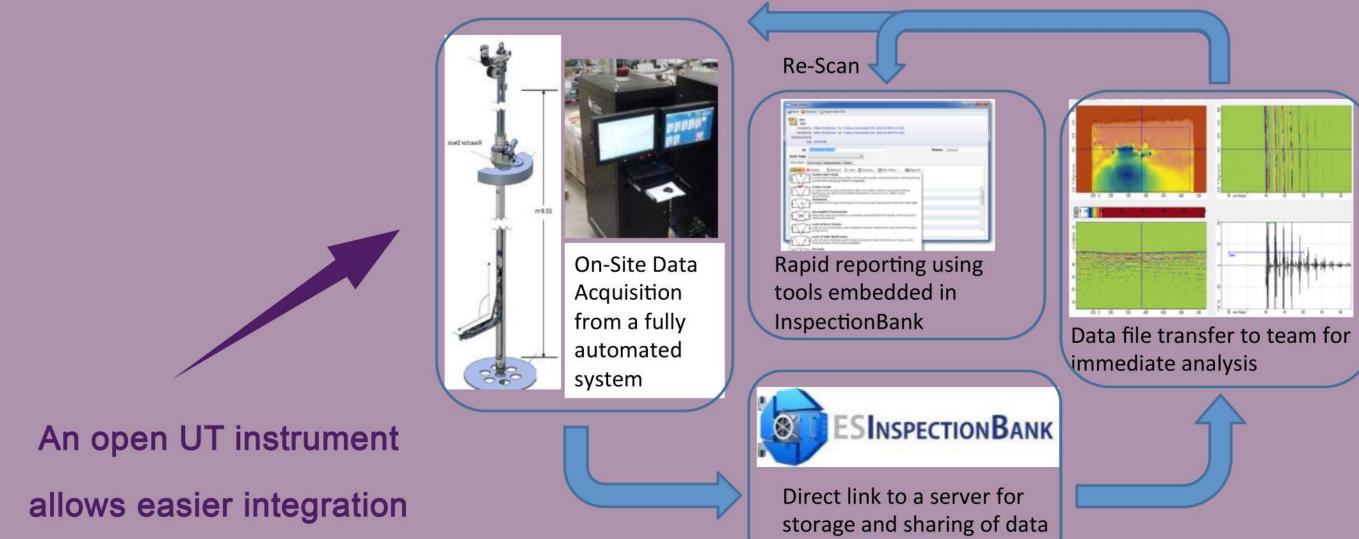

OPEN PLATFORM

- Flexible and Scalable Hardware
- API and Plenty of Example Source Code
- Acquisition Data: Simple call back function
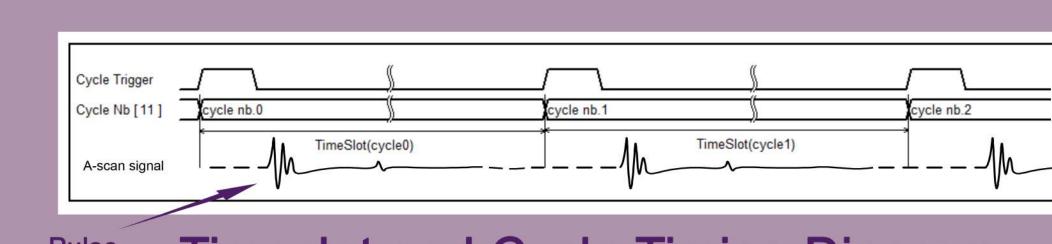- Two ways to setup the system
  - API Function Calls
  - OEMPA File

Management and Control Software

An open UT instrument allows easier integration

DATA RATE

- Instrument to PC Datalink (LAN)
  - Standard: 5MB/s (real data transfer)
  - Gigabit Ethernet: 10MB/s (real data transfer)

$$PRF = \frac{1}{timeslot} \quad ; \quad \text{# of A-Scan Points} = \frac{Range}{10ns} + 1$$

- DataRate = PRF × Number of A-scan Points
- Example:
  - DataRate = 10kHz × 1000pts = 10MB/s
  - Assumption: Each point = 8-bits

Pulse   Timeslot and Cycle Timing Diagram

Software Architecture