



**Improved NDI efficiency using
NDEToolbox™ and automated
data processing**

The NDE group at TRI Austin focuses on developing inspection procedures that improve inspection accuracy while decreasing processing time through integration of cutting-edge software and hardware to minimize user error caused through repetition and fatigue.

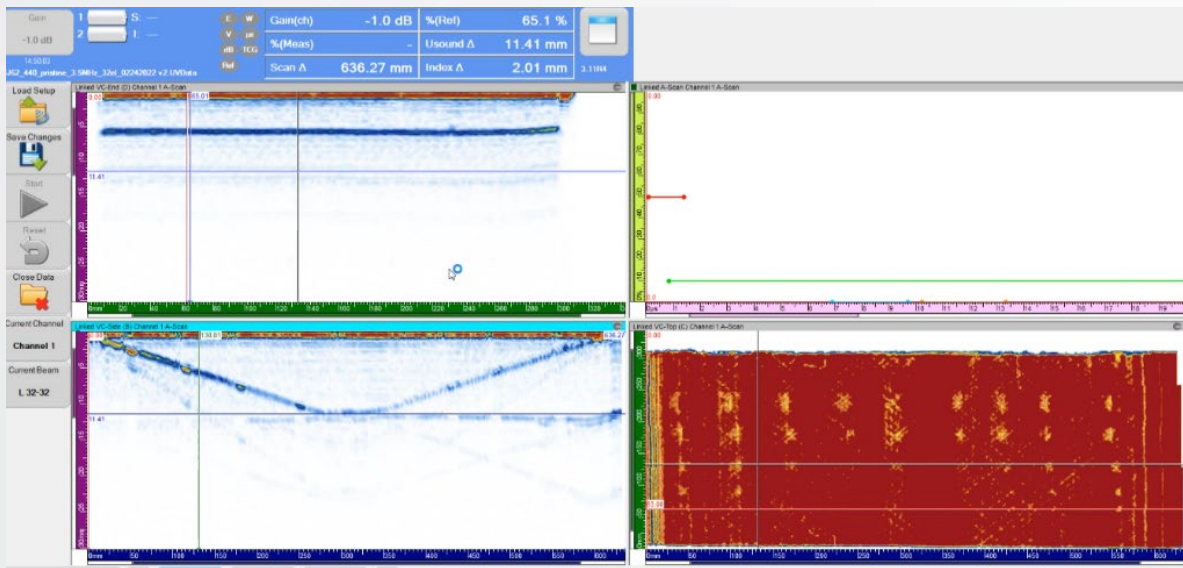
- Technique and Product Development
 - UT, EC, μ W, AE
 - Data and Information Analysis
 - Automated Data Analysis, Combined IAC, Modeling, Visualization, ML/AI for NDE
 - Technique and Product Evaluation
 - POD Studies, EVi, MVP, LBI, Topaz
 - Level III Consulting (Certification Preparation)
- Specimen Design and Fabrication
 - Controlled Known Realistic Defects (e.g. Fatigue Cracks, ALT Corrosion, Impact Damage)
 - Non-Standard Materials Testing
 - Working with other manufacturers to improve products
 - Integration with complementary technologies (e.g. robotics, VR, XR)

- TRI has developed and implemented an inspection data viewing and processing software. NDEToolbox™
- The software interfaces with several NDI techniques and data formats, these slides will show ultrasonic techniques.
- The software automatically processes data according to individual work procedures and generates a report. (Assisted Defect Analysis)

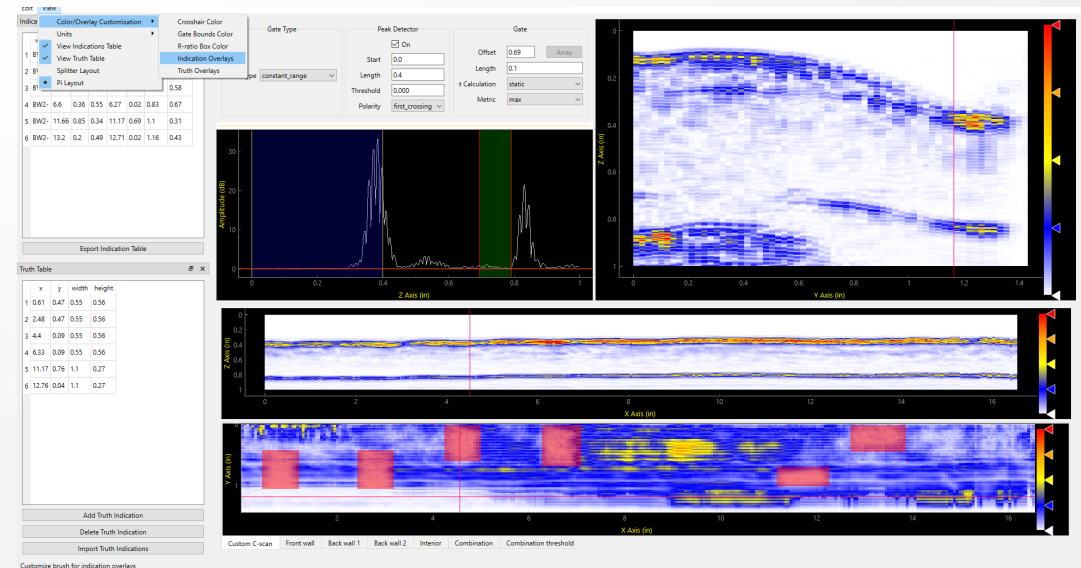
- TRI has consistently helped to solve challenge problems related to difficult to inspect areas and multilayered structures
- As ultrasonic technology has evolved linear and matrix array UT transducers have replaced single element transducers at many airframe manufacturers and maintenance centers
- NDEToolbox™ can be configured to automate data processing for any existing system and easily updated as inspection processes are updated.

Introduction to NDEToolbox™ and ADA

- NDEToolbox™ reduces inspectors' time to interpret large data sets from **hours to minutes** (based on observation of work timelines and demonstrations of ADA). Minimizing Aircraft on ground time (AOG) through efficient and thorough data processing and tracking.
 - The software is operated through a user interface designed to mimic user interfaces on currently existing products.
 - Implemented in the NDI capabilities for **four** DOD aircraft with a **fifth** in process.
 - Implemented for use on as-manufactured inspection of components for **one** passenger aircraft



Screenshot of a typical ultrasonic data post processing software

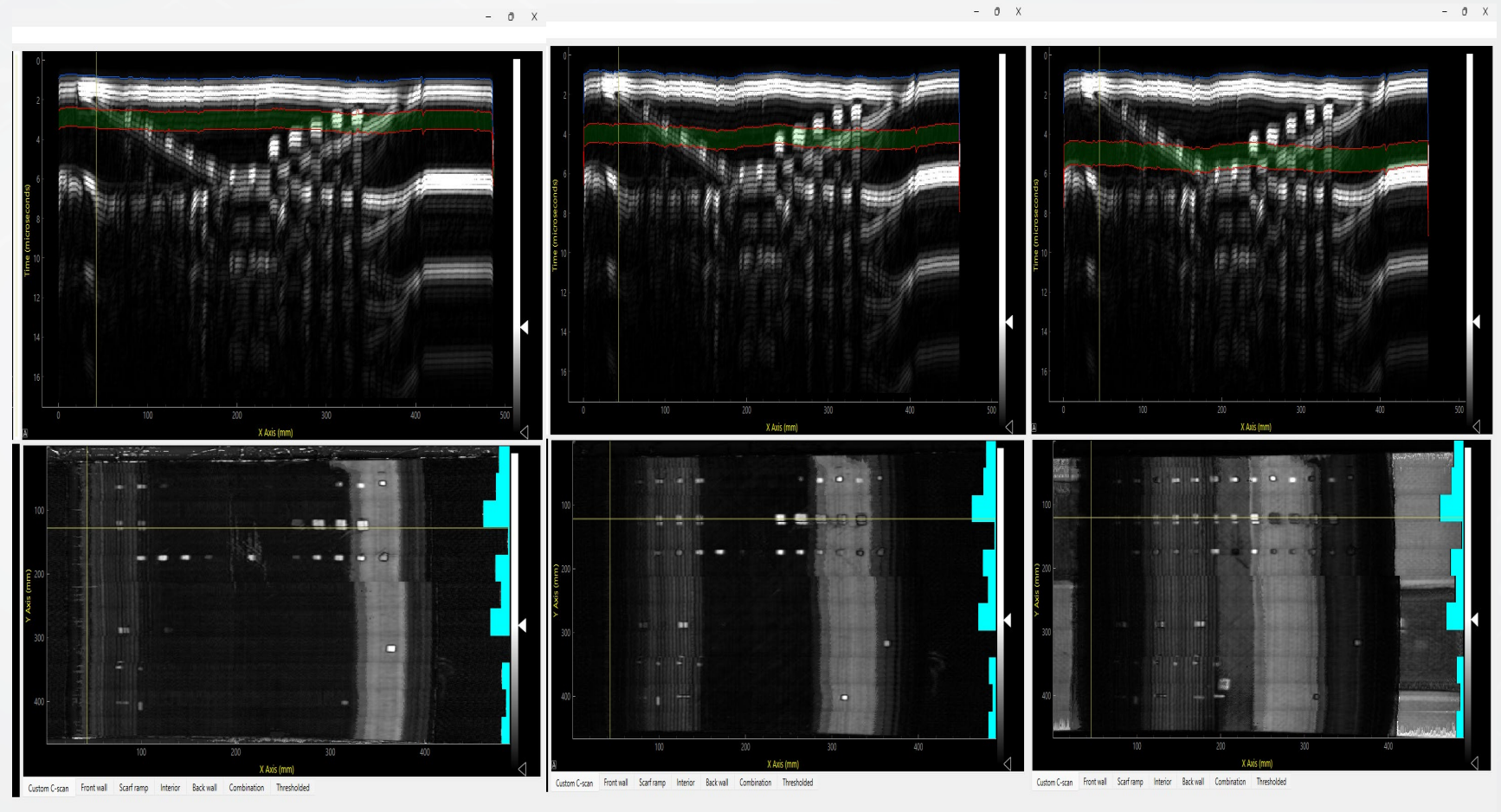


Screenshot of NDEToolbox™

Inspection of Complex Structures is Difficult

Inspections often require several manual steps, requiring inspectors to adjust gates and criteria at each location (i.e. green gated area).

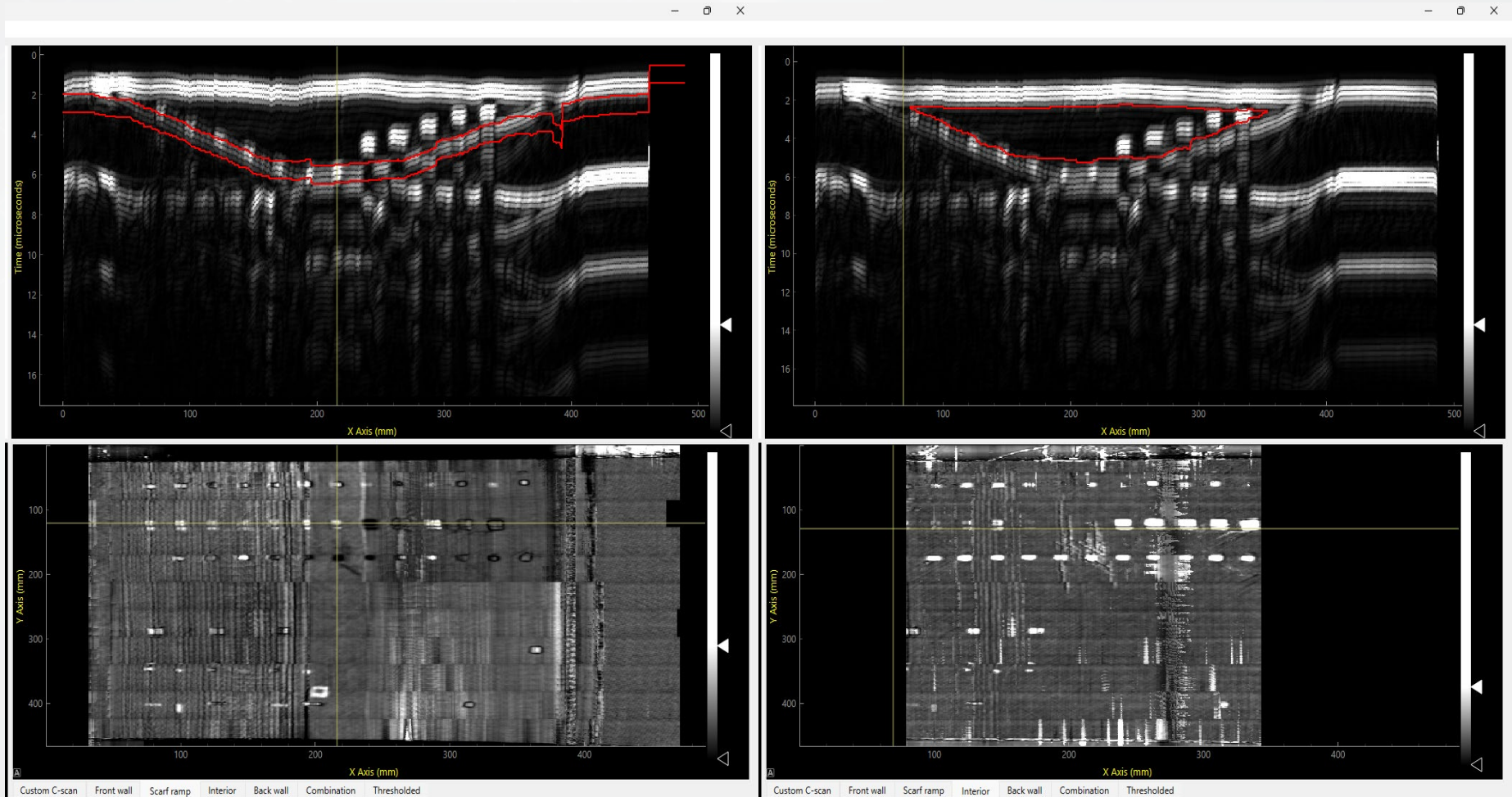
This results in only certain areas to remain in focus. Demonstrated on bottom right row of images



Varying gate locations (top row) help identify defects at different through thickness locations (bottom row)

NDE Toolbox Makes it Easier and Assisted

NDI toolbox with ADA dynamically adjusts the gating for continuous processing of the entire data set eliminating repetitive inspection steps

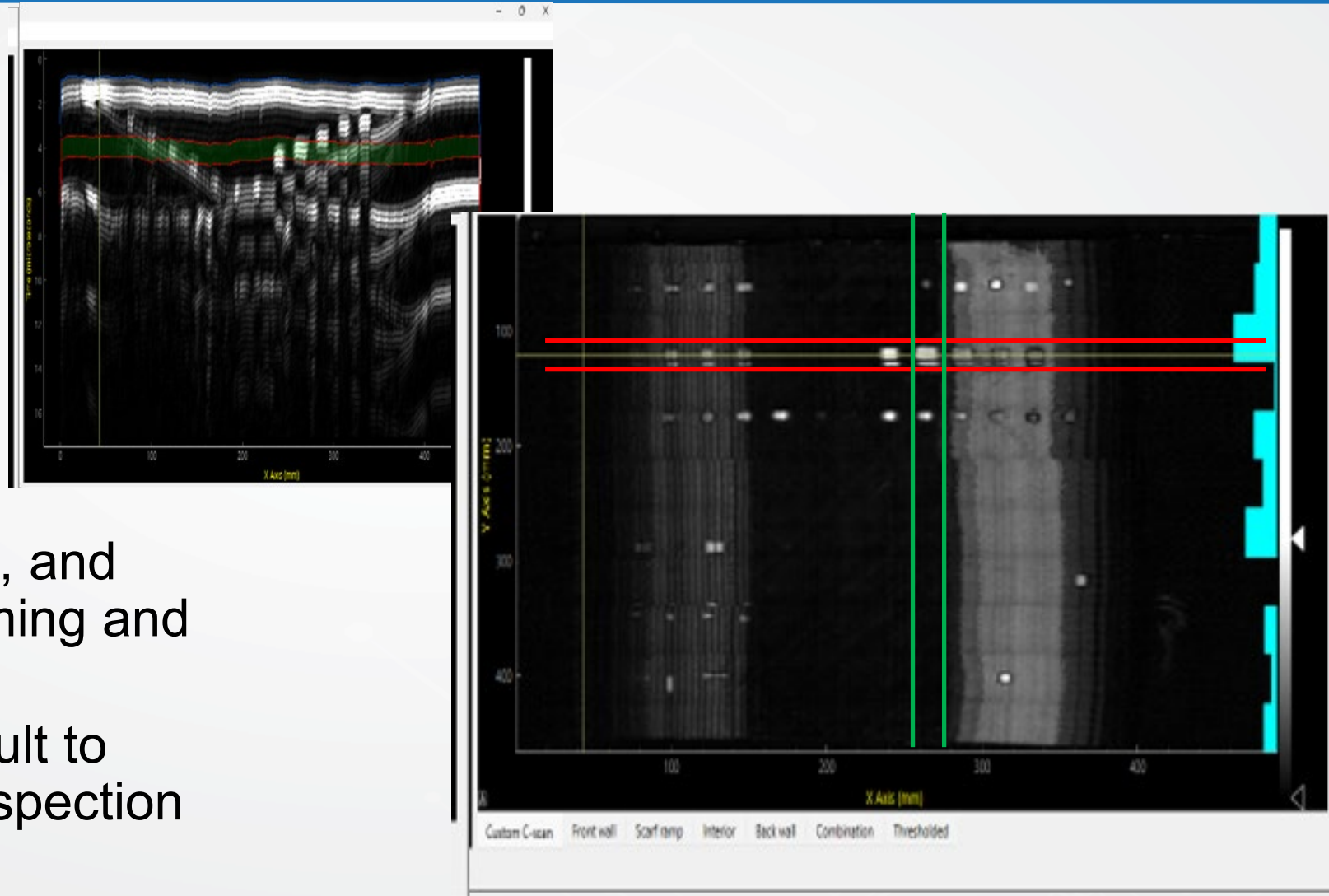


Automatically detected and tracked interface (top left) and automatically gated area between interfaces (top Right)

9063 Bee Cave Rd., Austin, TX 78733, tri-austin.com

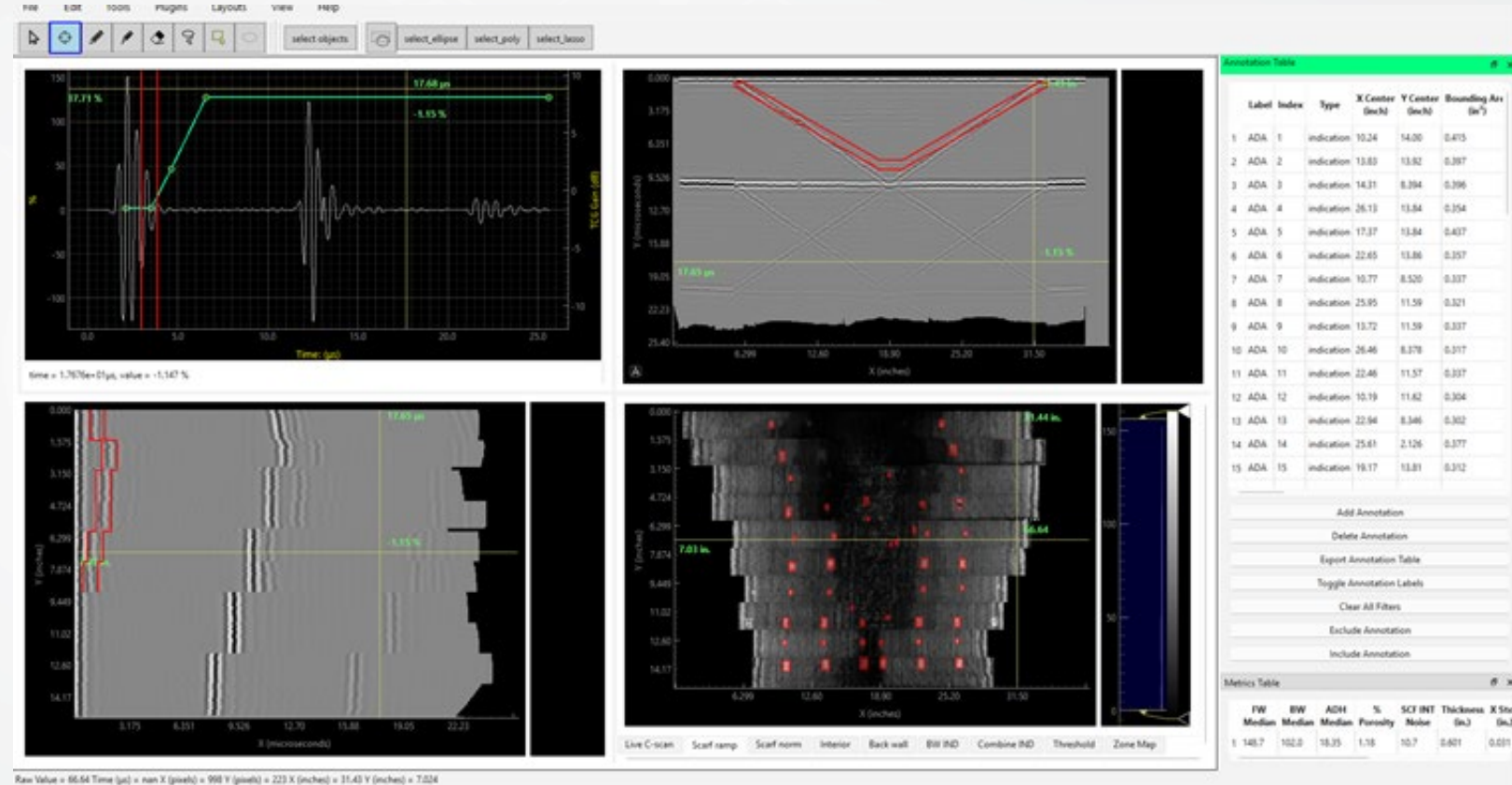
Defect Analysis

- Defect sizing, grouping, and notating is time consuming and tedious
- Documentation is difficult to accurately transition inspection data to other groups



Automatic Defect Analysis Results

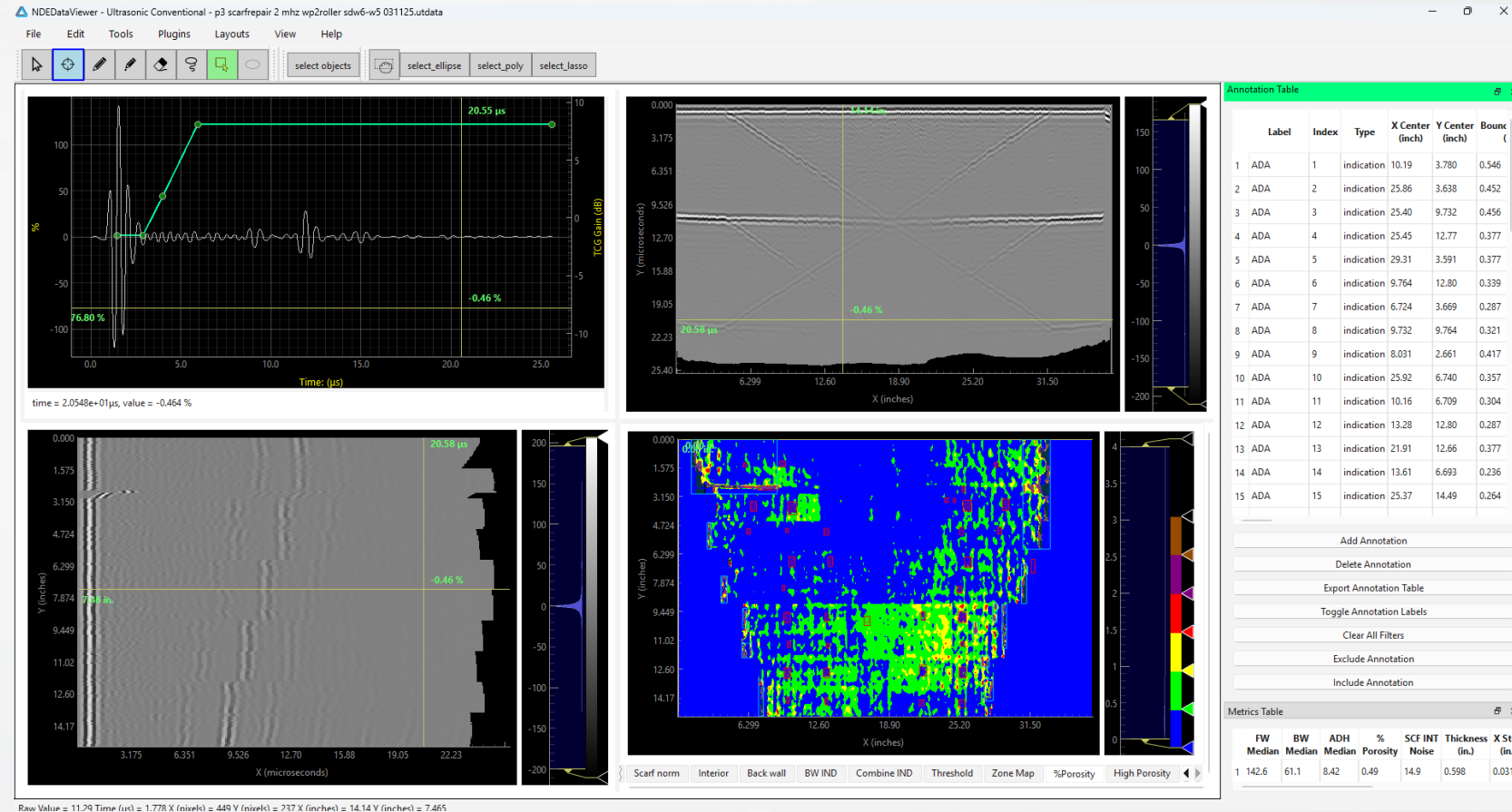
- Defect sizing, locating and description are all automated and digital
- Directly exportable to effects of defects models



Screen shot of NDEToolbox™ with ADA highlighting defects (bottom right) within the selected time of flight (Top Left) and a list of all ADA found defects and size presented on the far right.

Automatic Defect Analysis Results

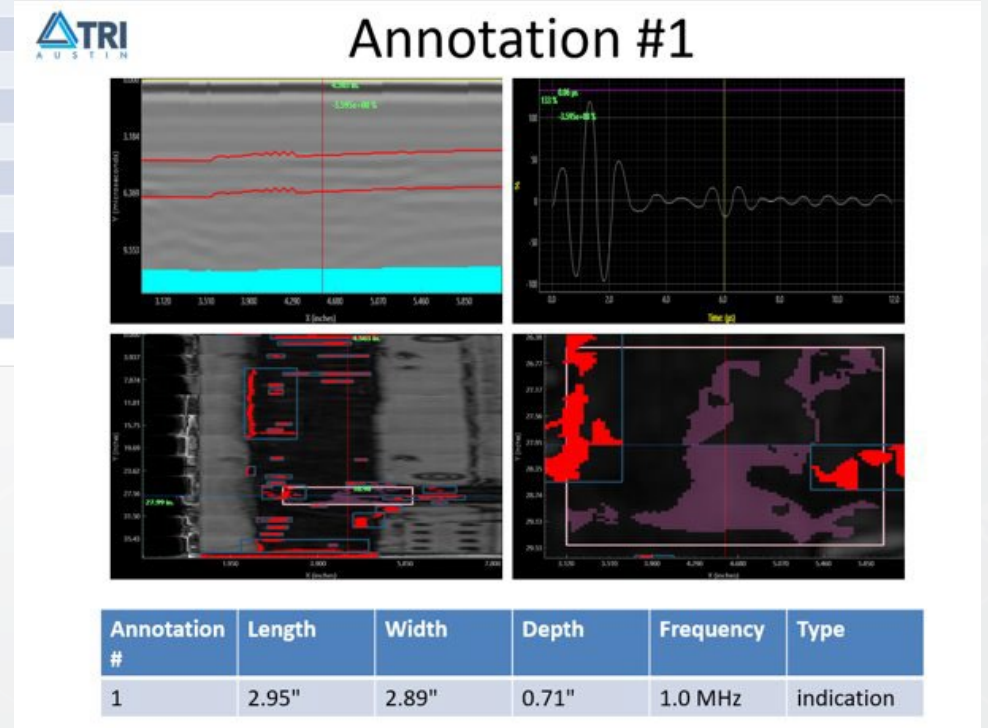
- During inspection of composite structures and repairs the ADA can also provide a visual map of 'porosity'



Screen shot of NDEToolbox™ with porosity visual overlay (bottom right)

- Company specific reporting templates can be applied for automated reporting.

Annotation Header Page									
Annotation #:	Type	Length:	Width:	Depth:	Max Amplitude:	Mean Amplitude:	Discrepancy Type:	A-Scan Validation: (Inspector)	Reviewed By: (Level III)
1	indication	2.95"	2.89"	0.71"	23.08	14.20	undetermined		
2	indication	0.87"	3.98"	0.54"	9.74	5.31	undetermined		
3	indication	12.24"	1.17"	0.63"	40.52	26.68	undetermined		
4	indication	0.79"	2.38"	0.83"	41.62	18.48	undetermined		
5	indication	2.20"	2.85"	1.16"	42.75	21.55	undetermined		
6	indication	2.36"	0.98"	0.76"	18.94	13.22	undetermined		
7	indication	0.63"	1.64"	0.83"	25.20	20.19	undetermined		
8	indication	2.48"	0.70"	0.80"	35.64	23.03	undetermined		
9	indication	0.67"	1.83"	1.15"	14.73	11.85	undetermined		
10	indication	0.51"	1.95"	0.71"	25.31	20.55	undetermined		
11	indication	0.75"	0.78"	0.85"	41.83	29.71	undetermined		
12	indication	1.10"	0.59"	0.74"	56.23	35.41	undetermined		
13	indication	0.43"	0.70"	0.70"	26.14	21.53	undetermined		
14	indication	0.35"	1.13"	0.71"	26.45	21.14	undetermined		
15	indication	0.59"	1.09"	0.71"	32.69	15.90	undetermined		



Demonstrated on Multiple Complex Structures

- The user interface can be customized to fit end user preference
- All data presentation visuals can be toggled (on/off) and displayed as needed during the workflow

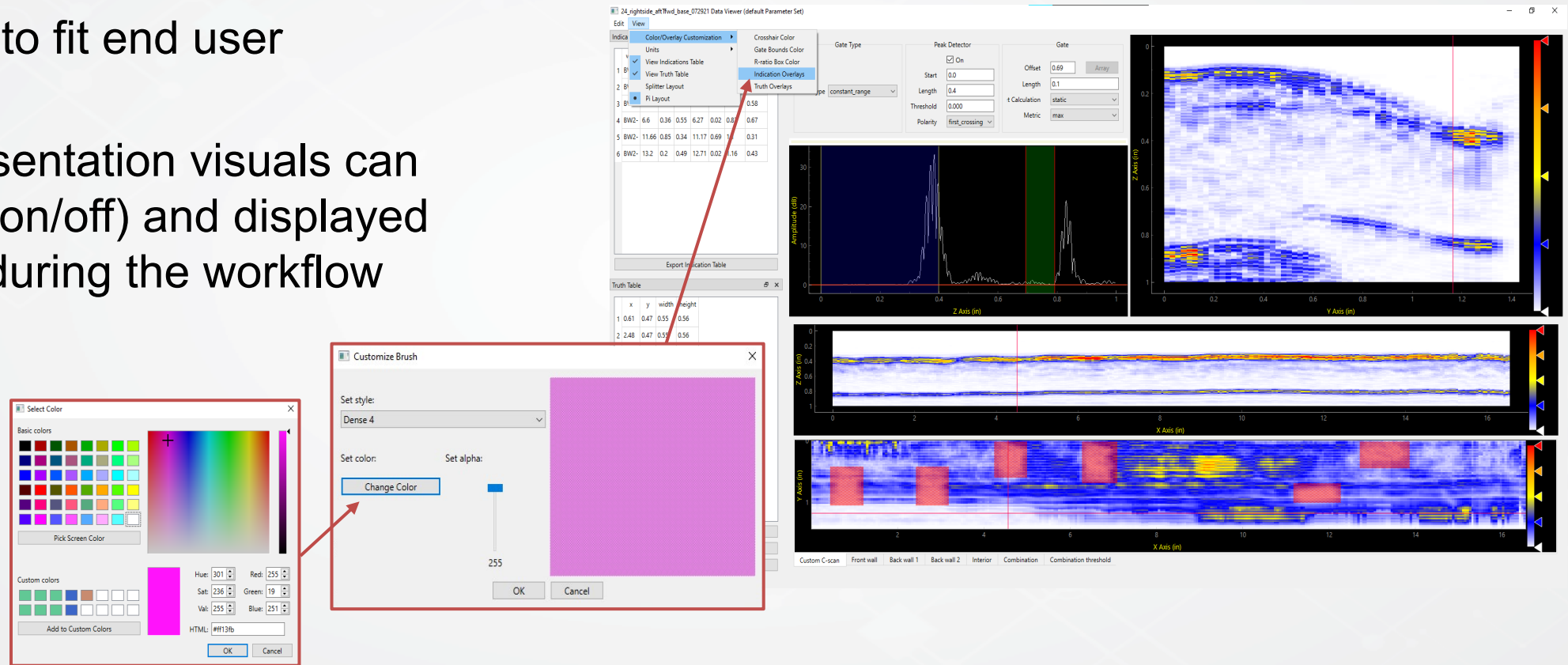
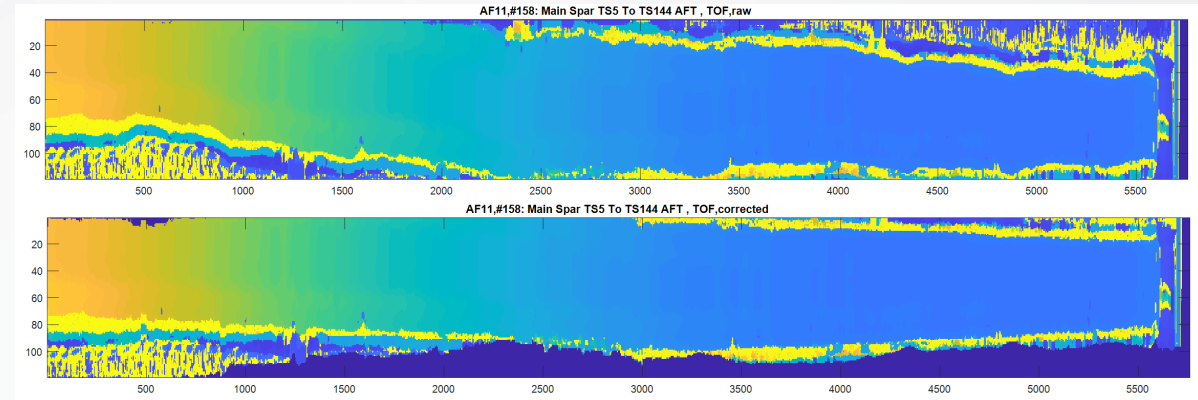
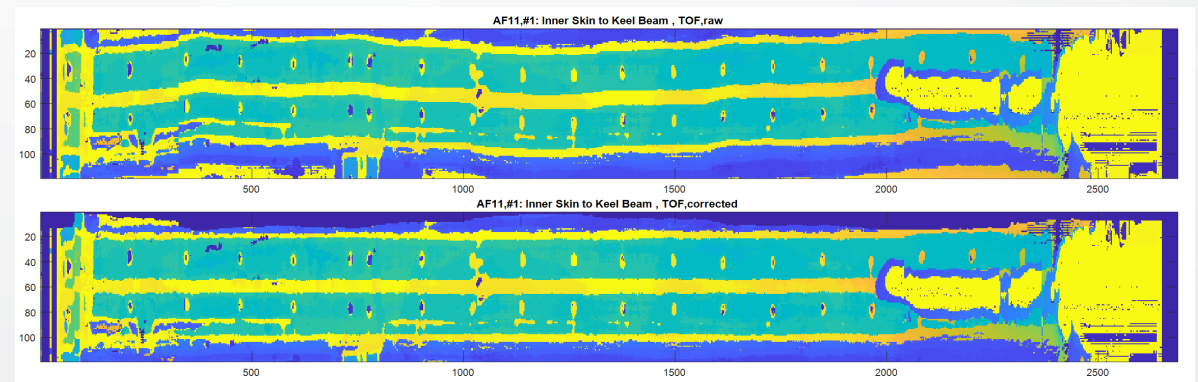


Illustration of user interface customizability

- Inspection data requires special handling
- Multiple scans can be stitched together to ensure large acreage coverage
- NDEToolbox™ also has the capability to correct data and register with CAD model of the structure allowing integration with:
 - digital twin
 - support effects of defects models
 - evolution of the structure through the lifecycle



Geometric alignment: before (top) and after (bottom) alignment

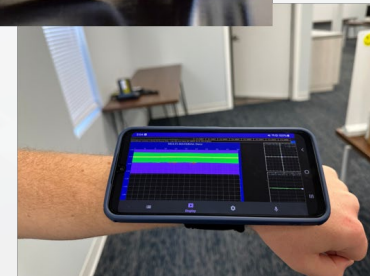


Geometric alignment: before (top) and after (bottom) alignment

- NDE Toolbox is a platform to develop specific algorithms for specific applications.
- Provides analysis of complex (or simple and large) data sets
- Can be implemented with single element UT, phased array UT, eddy current inspections (bolt hole), and others.
- Faster, more consistent, and fully digital

Enhanced Inspection Techniques

- TRI has paired NDIToolbox™ in conjunction with other modernization capabilities depending on customer goals.
- These capabilities minimize inspector fatigue and inspection time while increasing data accuracy and inspector focus



- TRI has worked to implement this technology with several DOD and commercial aircraft platforms and would like to apply the optimization techniques to more of the aviation industry
- We look forward to any further questions and discussions

NDI Division Director



Doyle T. Motes III, P.E.

Office: (512) 615-4475
dmotes@tri-austin.com

Toolbox/ADA Engineering Manager



Jaspar Marek

Office: (512) 615-4454
jmarek@tri-austin.com