Thermal Wave Imaging, Inc.

Leaders and Innovators in IR NDI and QA

presented to

Boeing

Oct. 10, 2017

St. Louis, MO

About Thermal Wave Imaging, Inc.

- Founded 1992
- Located in Detroit, MI
- World leaders in Thermographic NDI
  - 2014 ASNT R&D Achievement Award
  - 2016 DOD Maintenance Innovation Challenge
  - 2016 ASNT Mehl-Lester Honor Award
  - 2017 DOD CTMA Award
- We turn R&D problems into working solutions using patented TWI technologies
  - Thermographic Signal Reconstruction (TSR)
  - Precision Truncated Flash Excitation
  - Parallel Processing and Analysis of IR Sequences
  - Automated Detection of Turbine Blade Blockages
  - Measurement of Porosity in Composites

Solutions at Every Scale

Handheld / Portable

Automated

Large Scale

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Making Thermography a Viable NDI Method

A Quantitative Assessment of Advanced Nondestructive Inspection Techniques for Detecting Flaws in Composite Laminate Aircraft Structures

March 2016 — DOT/FAA/TC-15/4

Final Report

Federal Aviation Administration
William J. Hughes Technical Center
Aviation Research Division
Atlantic City International Airport
New Jersey 08405

U.S. Dep…
Federal A…

A Quantitative Assessment of Conventional and Advanced Nondestructive Inspection Techniques for Detecting Flaws in Composite Honeycomb Aircraft Structures

December 2016 — DOT/FAA/TC-15/63

Final Report

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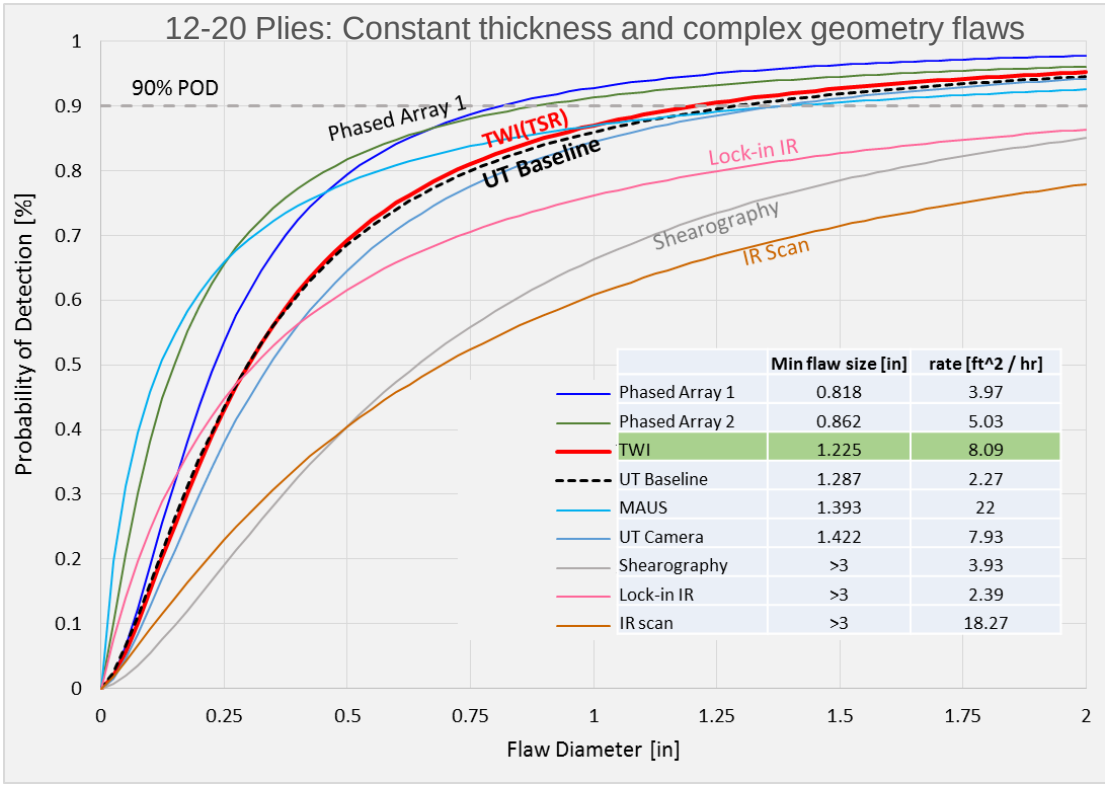


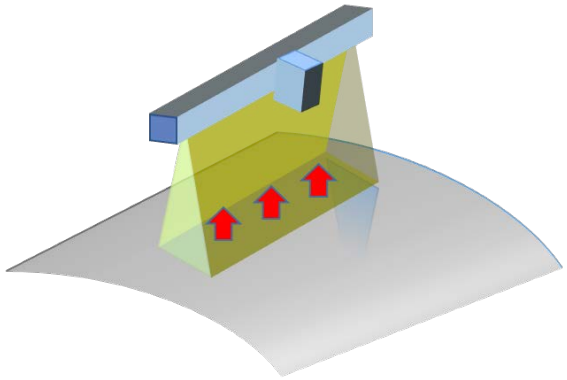
	Min flaw size [in]	rate [ft^2 / hr]
Phased Array 1	0.818	3.97
Phased Array 2	0.862	5.03
TWI	1.225	8.09
UT Baseline	1.287	2.27
MAUS	1.393	22
UT Camera	1.422	7.93
Shearography	>3	3.93
Lock-in IR	>3	2.39
IR scan	>3	18.27

- Among top 3 in POD, minimum flaw size and inspection rate (TC-15/4)
- Best performer of all thermography and shearography systems (TC-15/4)
- “Overall, when both 90% PoD levels and false calls are considered, thermography provided the best overall performance.” (TC-15/63)

Solving the Most Challenging Problems

Some Recent Examples

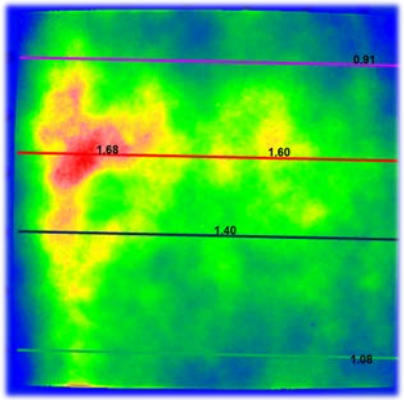
Automated Composite QA



Real-time FOD Detection

Projection Thermography

Aircraft Brake Inspection



Paint Thickness Measurement

CMC Hot Section QA

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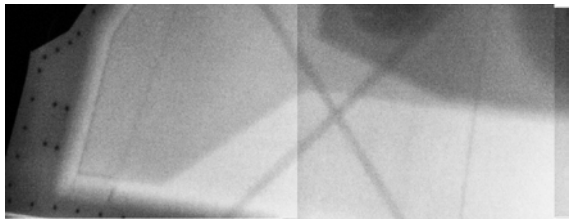
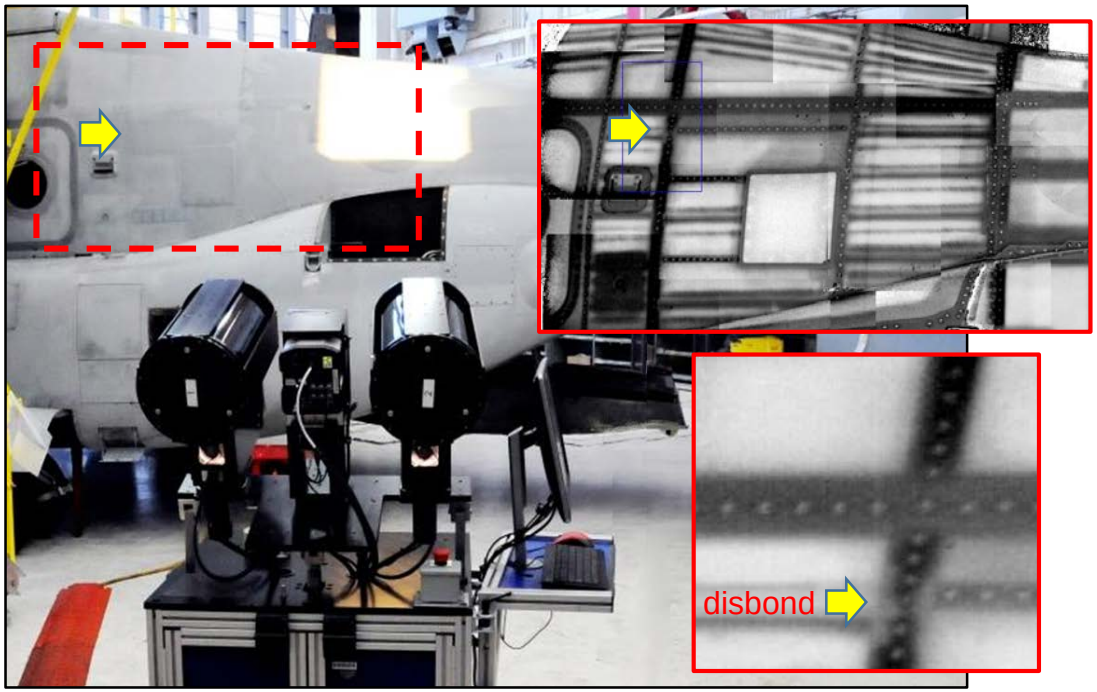
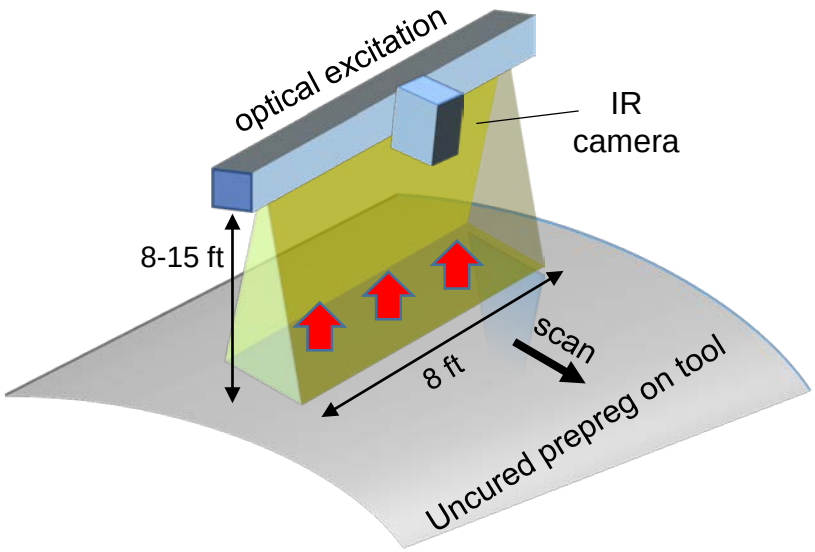
Large-Scale Projection Thermography



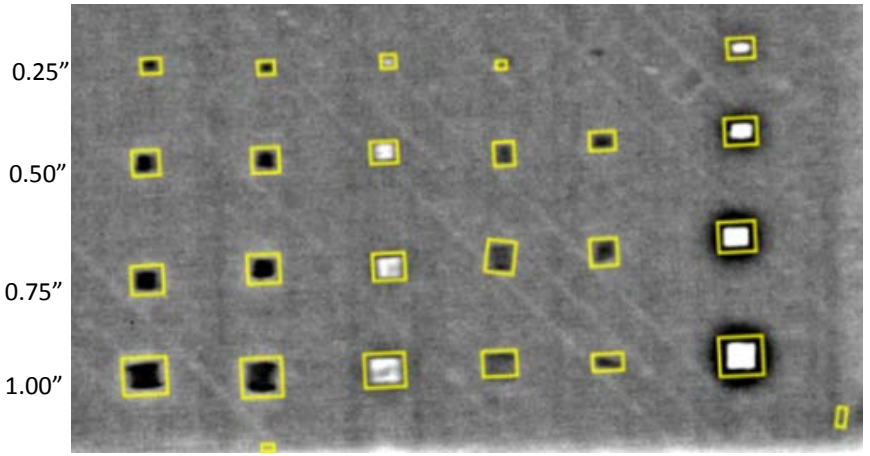


- Inspect large area from 10-15 ft standoff distance
- Fully automated inspection
- Inspect 80 ft^2 in 9 minutes
- TSR signal processing for enhanced flaw detection

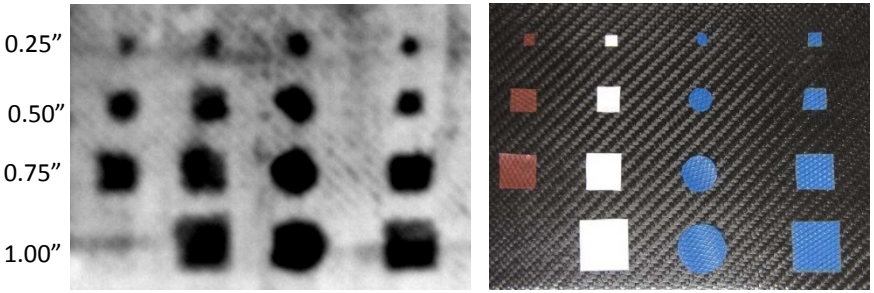
Real-Time FOD Detection



Automated detection of surface FOD
12 ft standoff, scan rate120 in / sec



Subsurface FOD in prepreg on tool



- Inspect prepreg on tool during layup
- Hand layup or ATL
- Detect surface and subsurface FOD
- 8 -15 ft standoff distance
- Inspection rate up to 120 in / sec
- Inspect 110 ft < 1 min
- Boeing TRL 9

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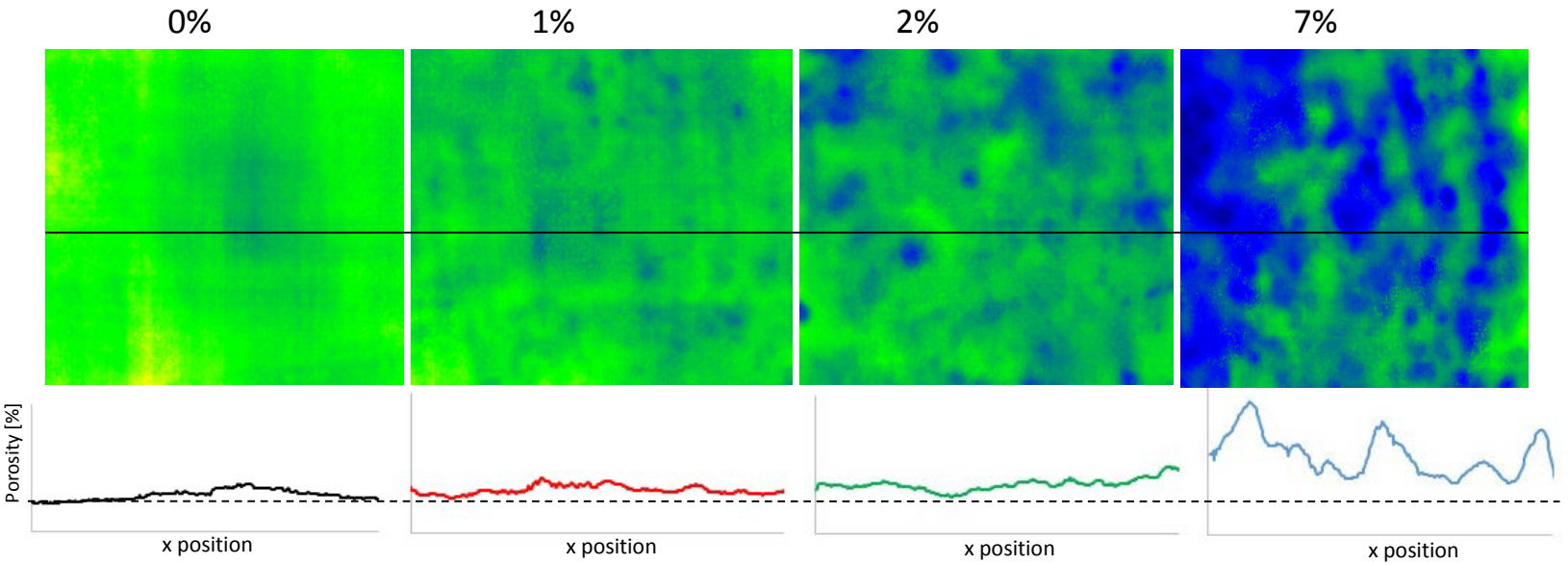
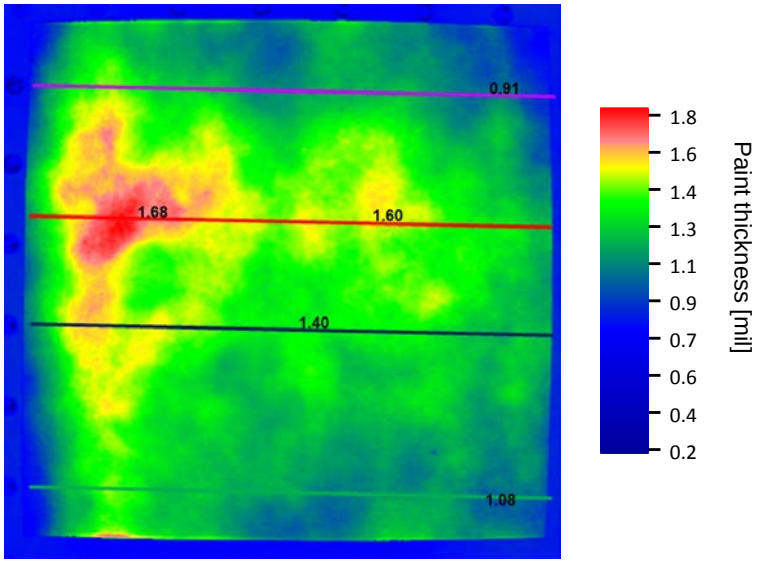
Single-Side Porosity Measurement

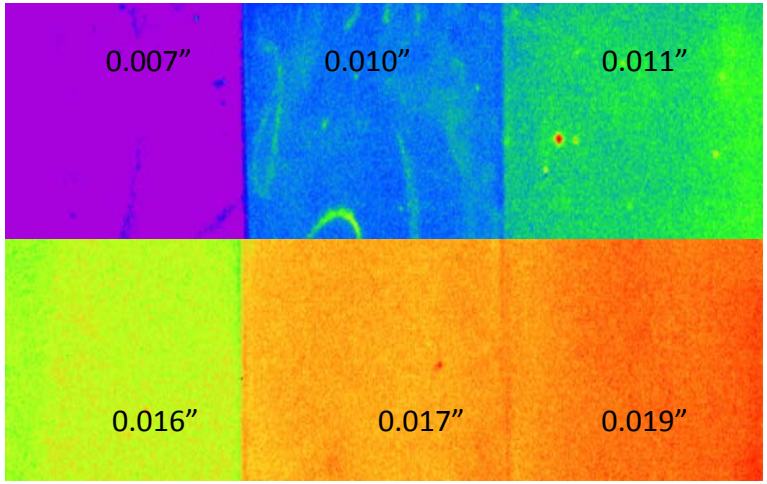


- Detection and measurement of <1% volume porosity in carbon epoxy composites
- Non-contact, single side access
- Compatible with curved surfaces and acoustic holes
- Provides porosity map of entire part

Ultra-High-Speed Thermography



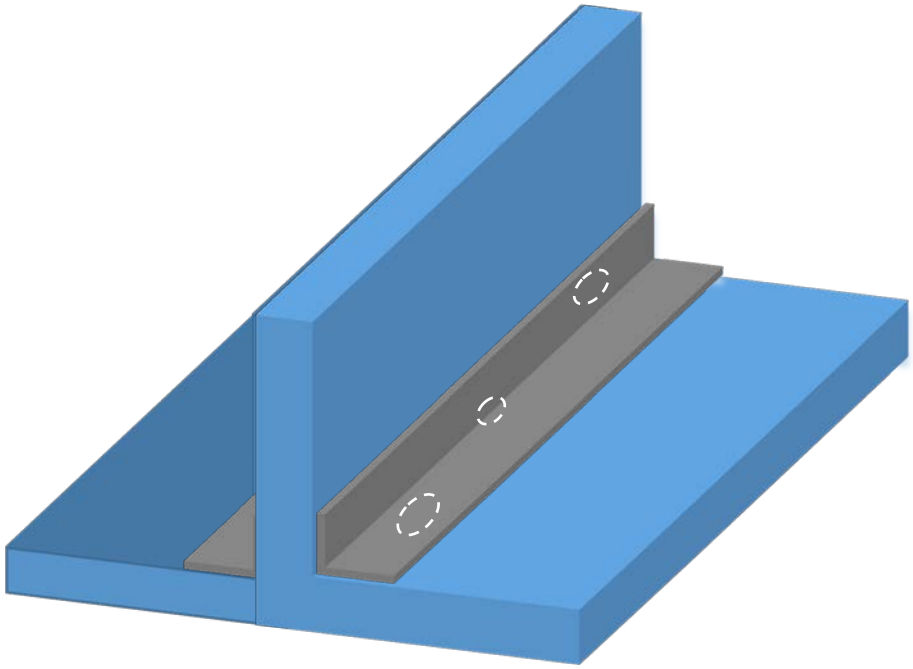
Thickness Map: Paint on Al



Metallic coating on steel: thickness measurement

- 5 kHz effective frame rate at 1K x 1K pixel density
- Result cannot be obtained with conventional IR camera technology
- Based on TWI precision flash truncation and TSR signal processing technologies
- Applications
  - Paint thickness measurement
  - Turbine blade bond coat thickness measurement
  - Characterization of heat damage

Inspection of Composite Radii



- Detection of disbond, delamination FOD or nonuniformity on tight radii
- Apply to structures where UT is not an alternative
- Also applies to leading edge

For More Information

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