

NDT for Non-Experts

2014 A4A NDT Forum

Jan O. Endrerud, VP Product and Marketing Dolphitech

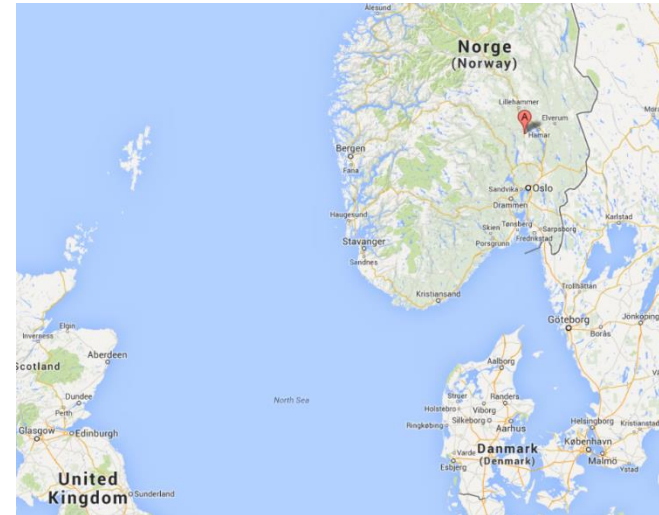
Agenda

- Who is DolphiTech?
- Technical background to NDT for Non-Experts
- What we are doing right now...
- What we will be doing next...
- Discussion – Q&A

Who is DolphiTech?

DolphiTech

- Electronics, FPGA, signal Processing, ultrasound and software development.
- Founded in 2009.
- Located in Raufoss, Norway.
- Sales office in Chicago, IL USA.
- Ultrasound cameras for NDT of composite materials.
- Unique ultrasound and transducer technology.



Technical Background

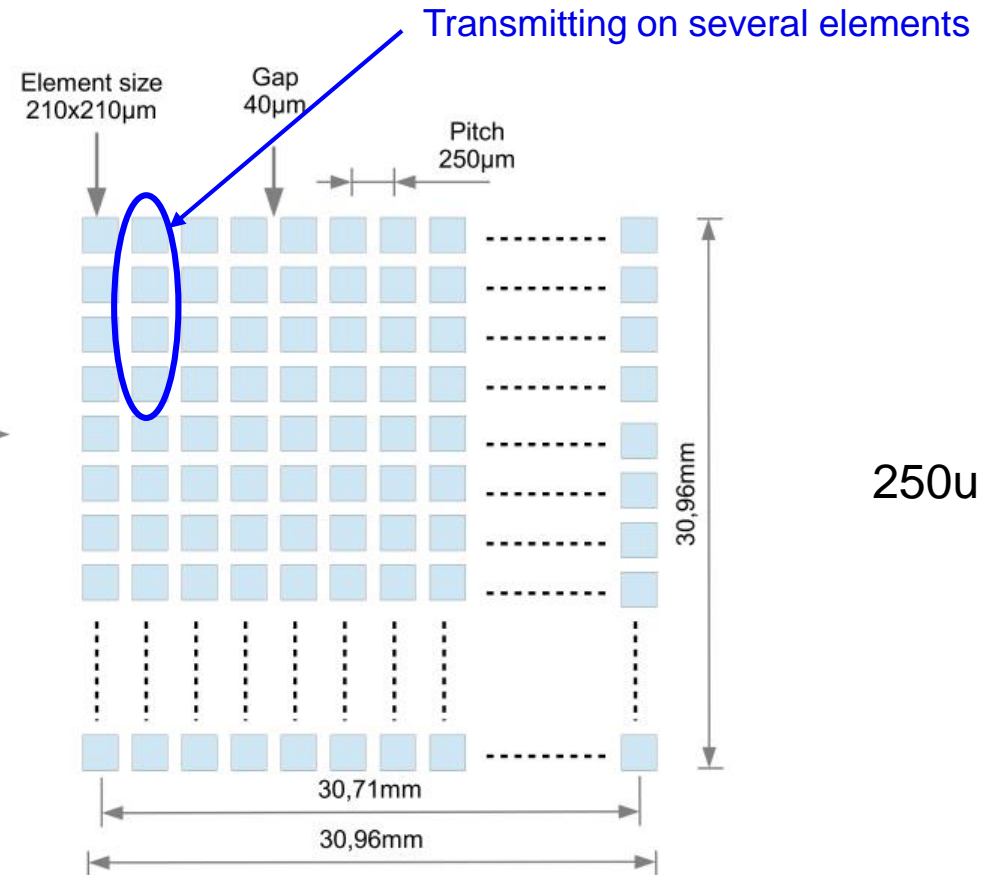
Eskil Skoglund, Head of Development

The DolphiCam CF08

- Handheld, high resolution, mobile ultrasound NDT camera with a dry coupling transducer design, for Windows PCs and tablets
- 16.000 transducer elements on 31x31mm
- Up to 8 mm CFRP thickness
- 2D and 3D images
- A-, B-, and C-scan (Amplitude & Time of Flight)
- Manual Stitching of larger areas
- Easily operated by non-experts
- Accepted in Boeing 787 NDT Manual

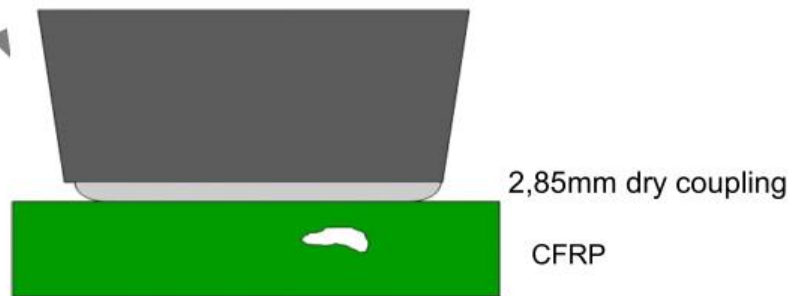


Transducer

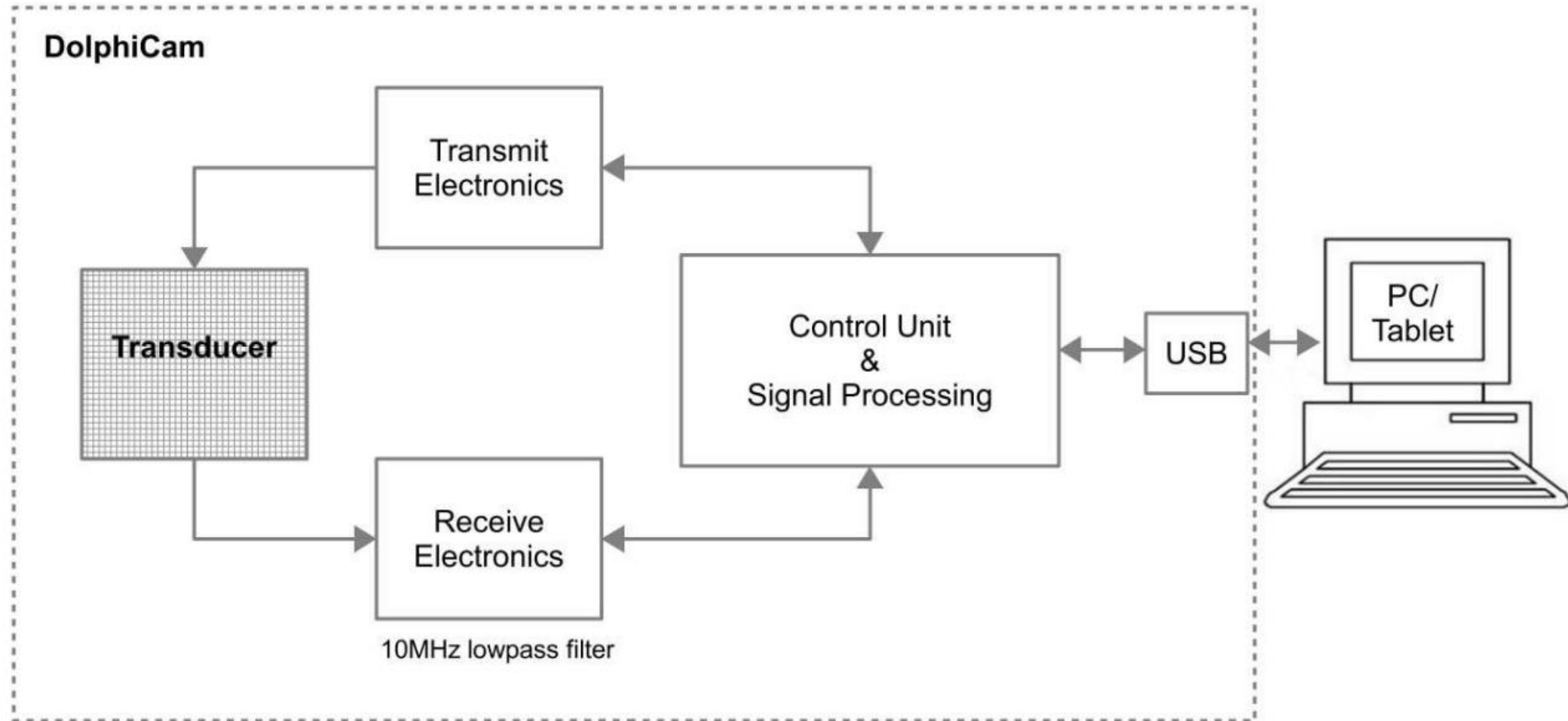


$250 \mu\text{m} = \sim 10 \text{ mills}$

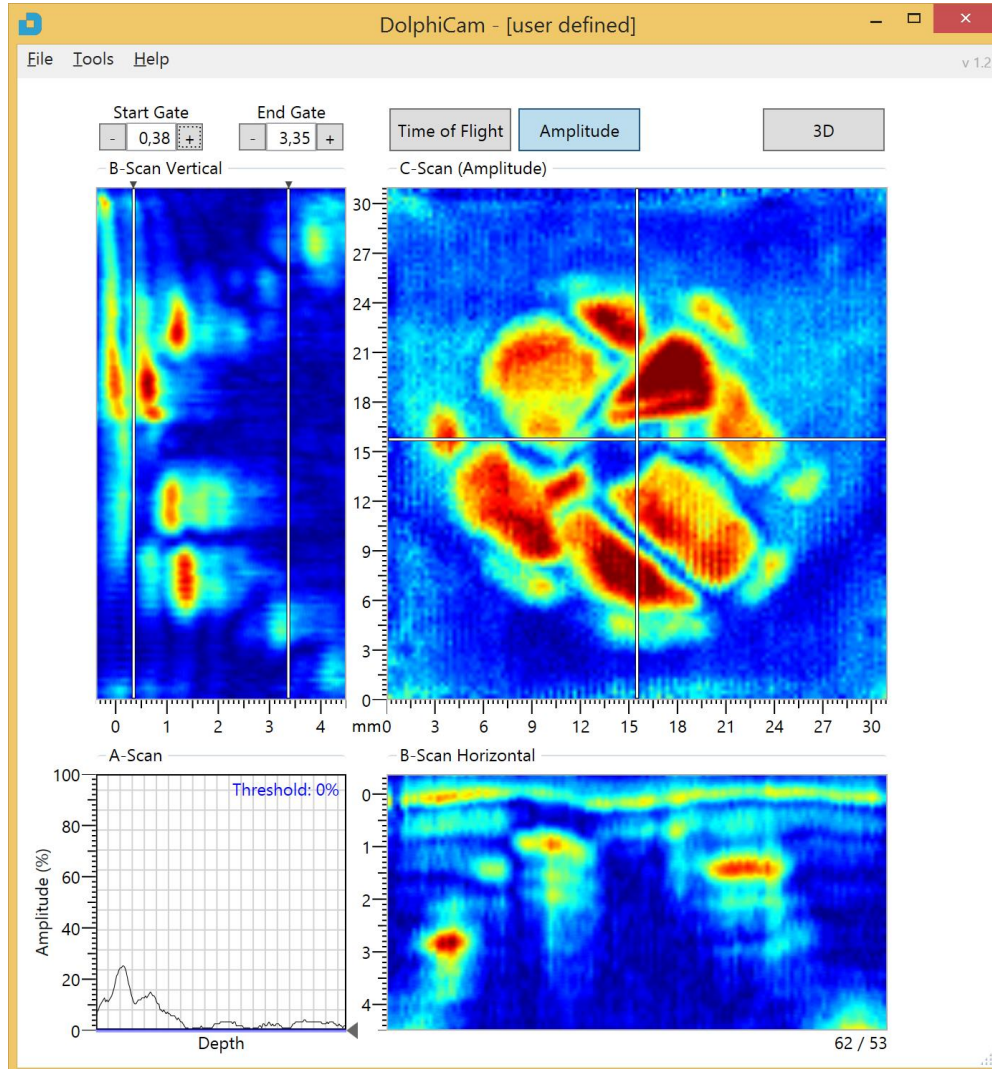
Side view



System Overview



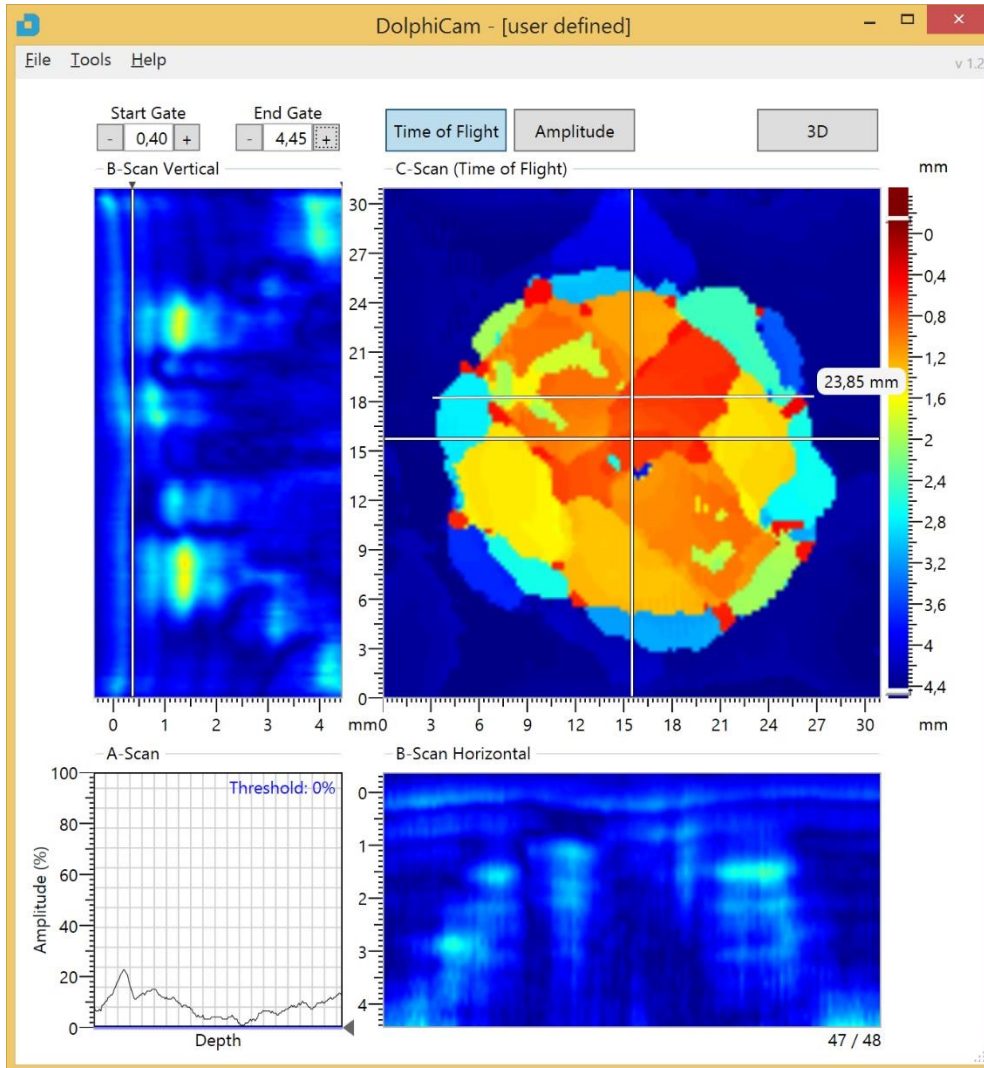
DolphiCam Expert



The screenshot shows the DolphiCam Settings dialog box with the following parameters:

- Unit:** Millimeters
- Material Depth:** 8.1 mm (sample 360)
- Number of Amplitude Gates:** 1
- Number of ToF Gates:** 1
- Material Sound Speed:** 3000 m/s
- Transmitting Elements:** 4 (default)
- Analog Gain:** 39.1 dB
- Number of Averages:** 2
- Transmitting Pulse Shape:** 1 (default)
- Time Corrected Gain:** Off
- Time of Flight Palette:** JetColorPalette
- Amplitude / B-Scan Palette:** JetColorPalette
- Amplitude Color Focus:** Auto
- Enable Sleep mode:** Auto
- Stitching Overlap:** 6.0 mm (25.0 mm*)
- Buttons:** Save..., Load..., Reset, Close

DolphiCam Expert

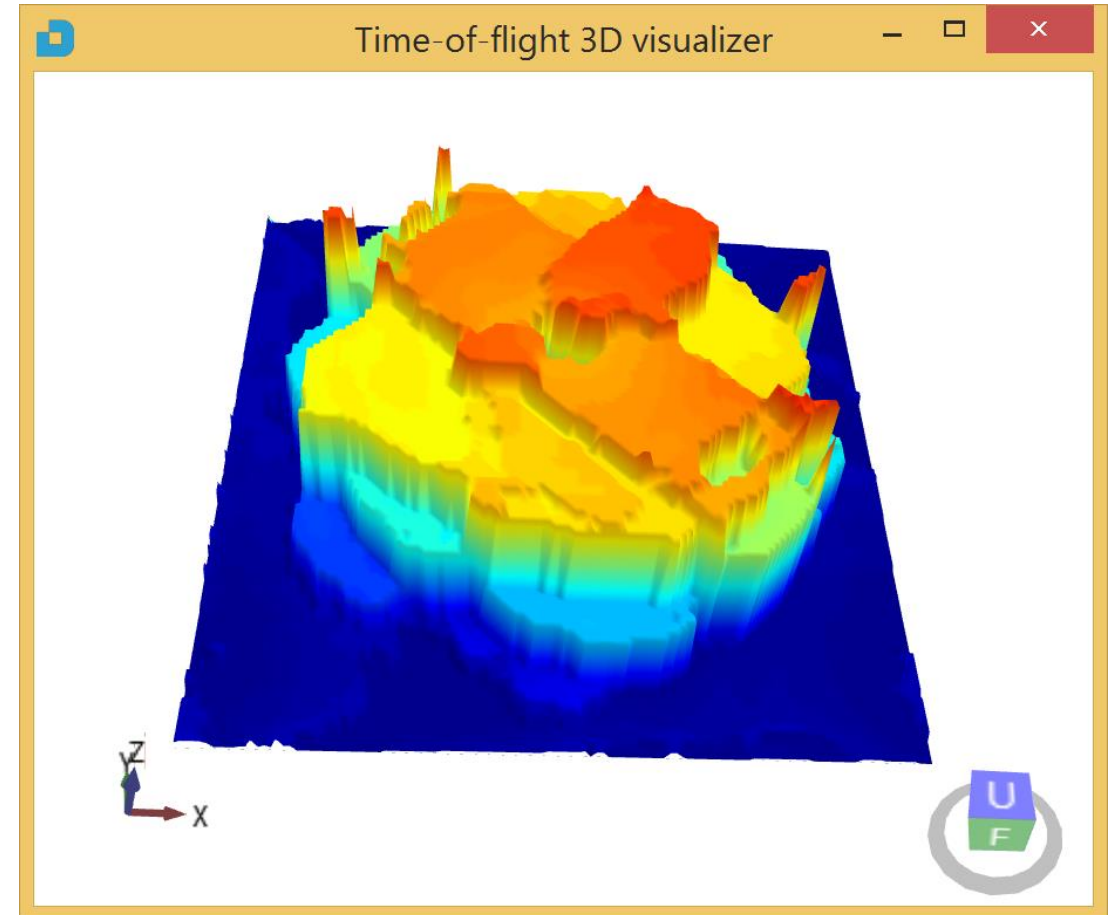
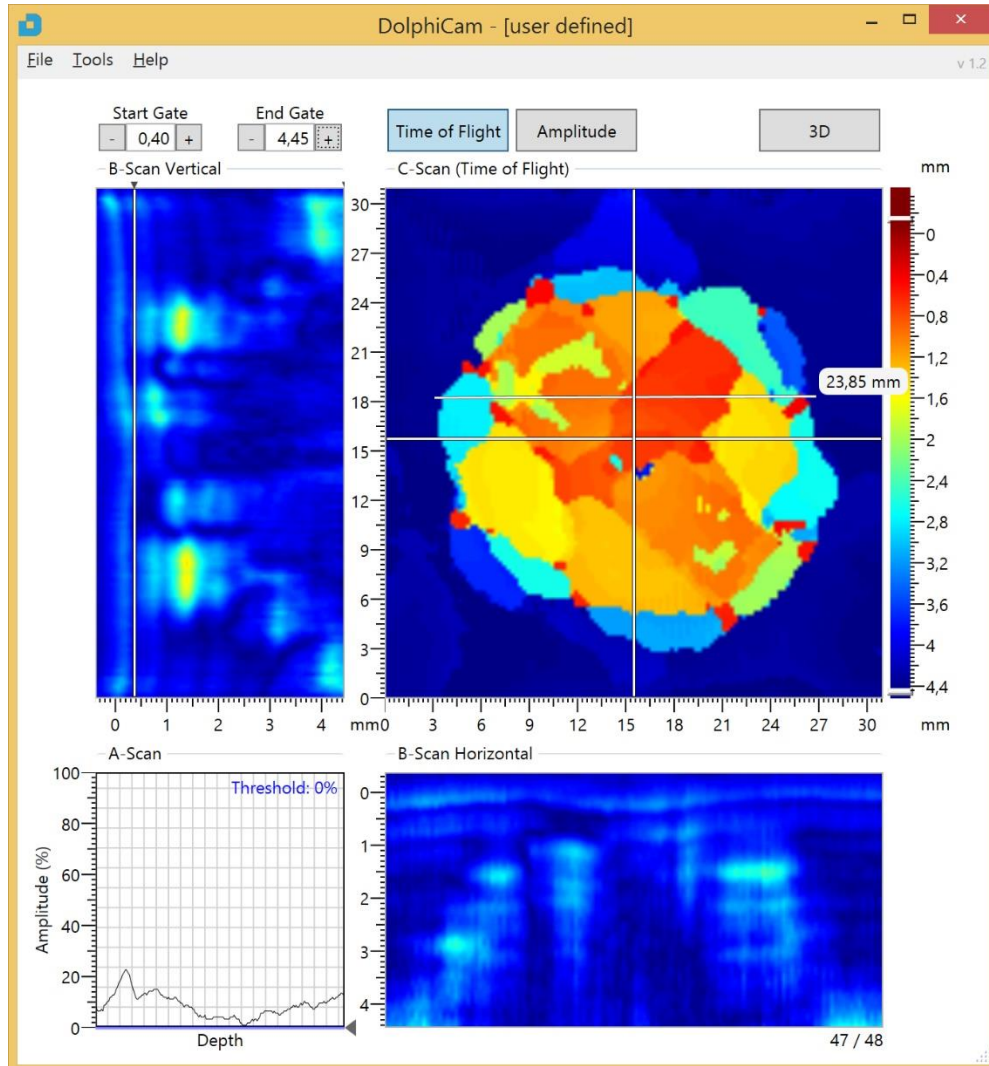


The screenshot shows the DolphiCam Settings dialog box. It contains the following settings:

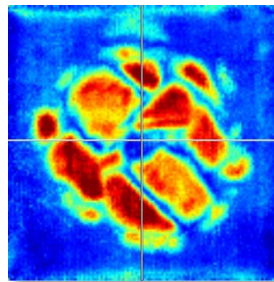
- Unit: Millimeters
- Material Depth: 8.1 mm (sample 360)
- Number of Amplitude Gates: 1
- Number of ToF Gates: 1
- Material Sound Speed: 3000 m/s
- Transmitting Elements: 4 (default)
- Analog Gain: 39.1 dB
- Number of Averages: 2
- Transmitting Pulse Shape: 1 (default)
- Time Corrected Gain: Off
- Time of Flight Palette: JetColorPalette
- Amplitude / B-Scan Palette: JetColorPalette
- Amplitude Color Focus: Auto
- Enable Sleep mode: Auto
- Stitching Overlap: 6.0 mm (25.0 mm*)

Buttons at the bottom include 'Save...', 'Load...', 'Reset', and 'Close'.

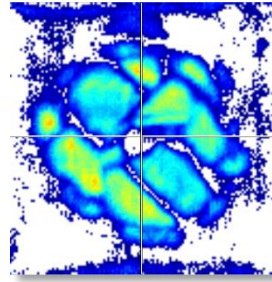
DolphiCam Expert



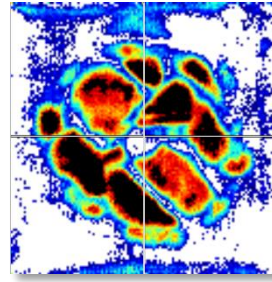
Color palettes



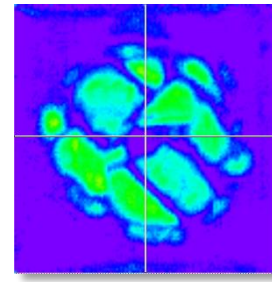
JetColorPalette



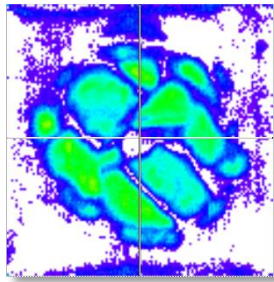
JetColorPaletteWhite



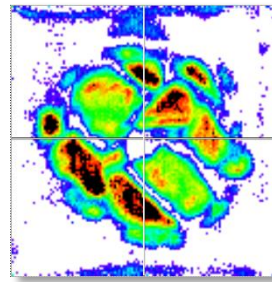
JetColorPaletteBlackWhite



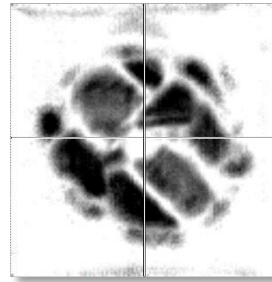
Rainbow



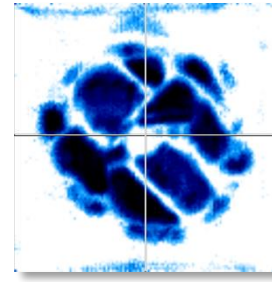
RainbowWhite



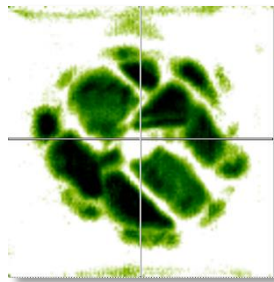
RainbowBlackWhite



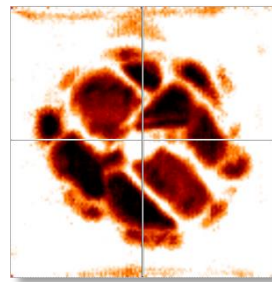
GrayWhite



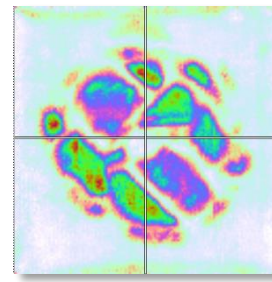
BlueWhite



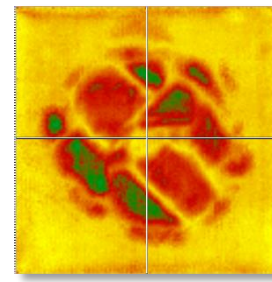
GreenWhite



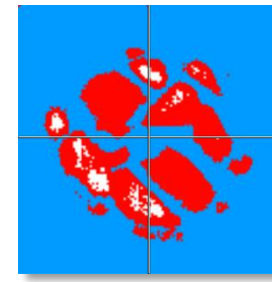
RedWhite



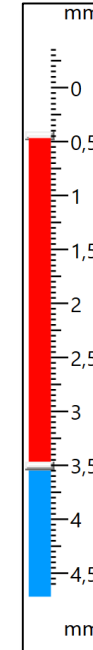
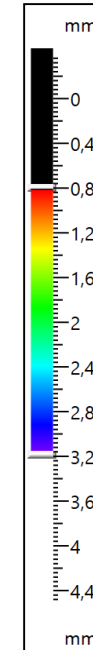
Color3Rounds



BlueGreenRedYellow



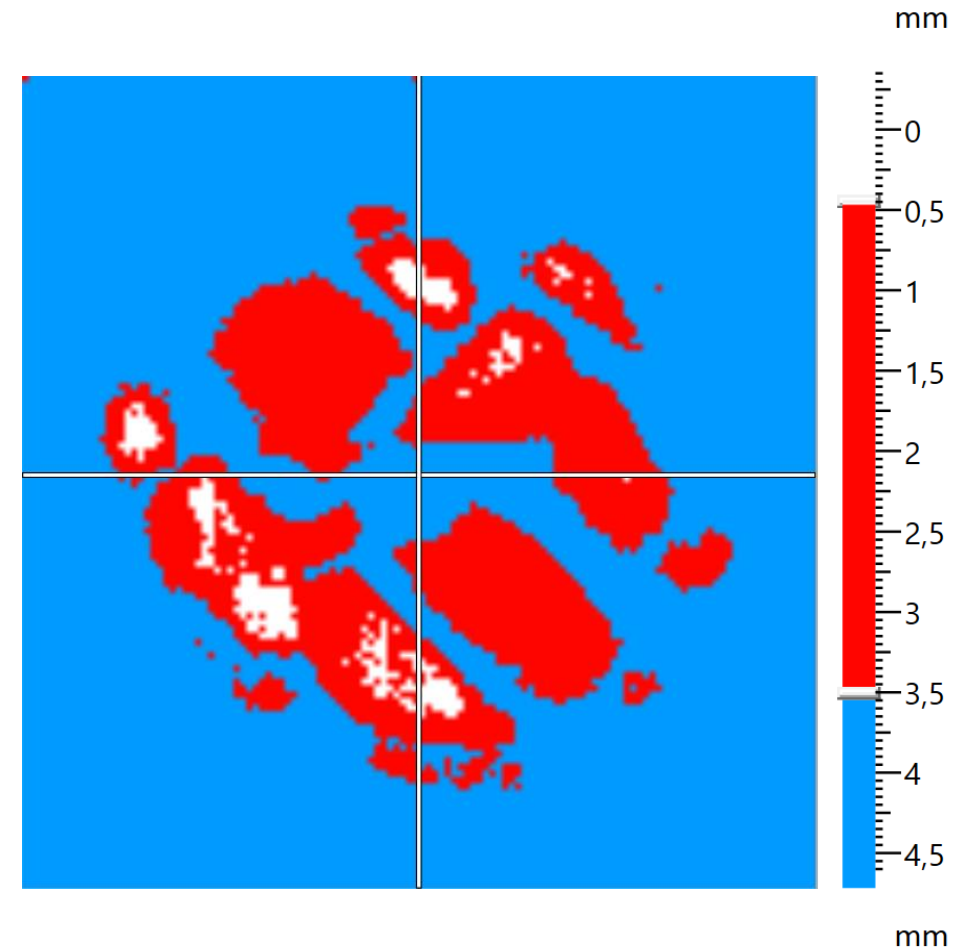
DiscreteWhiteRedBlue



“Traffic light” color palette

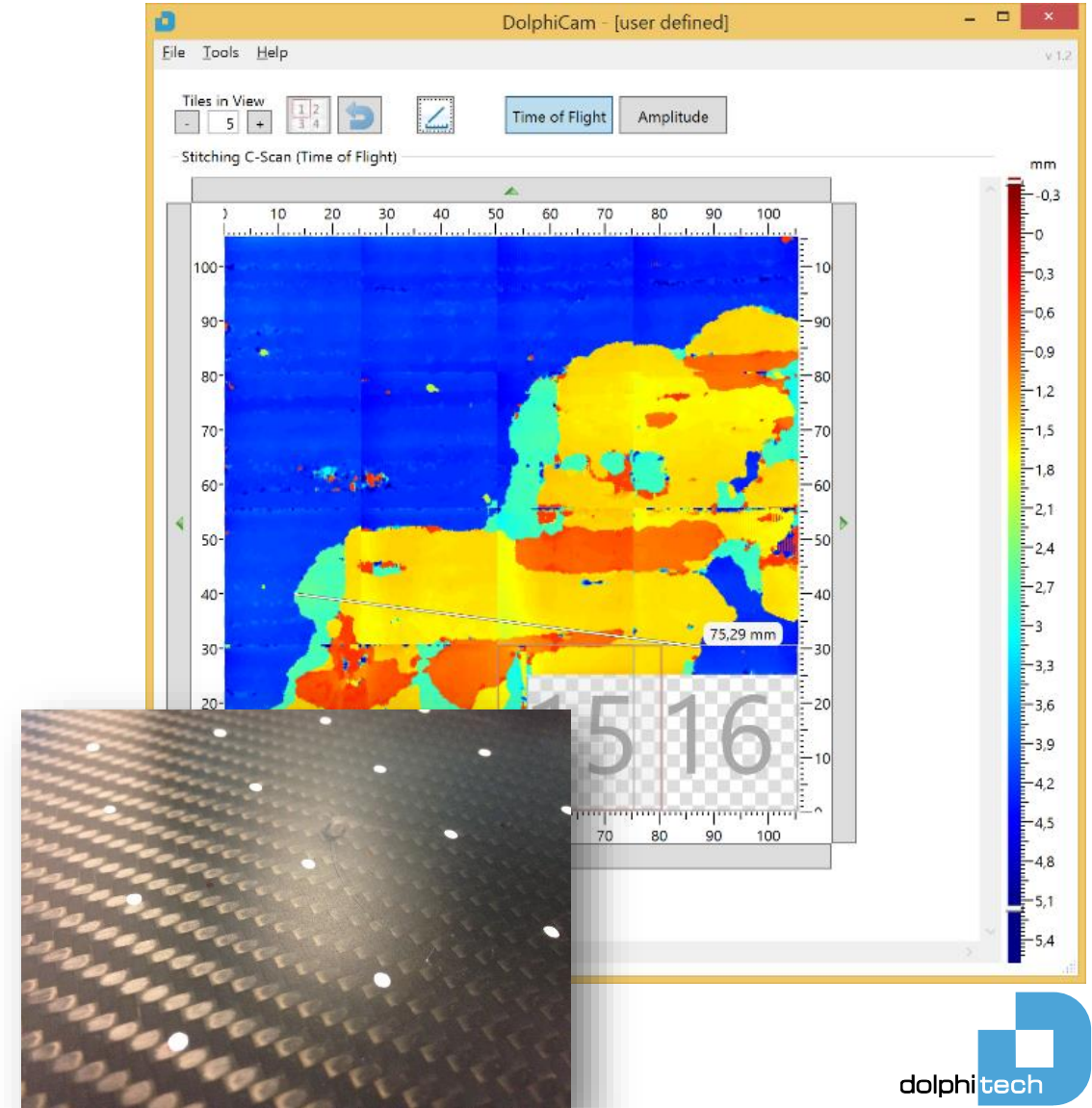
- Goal: Make it easy for non-expert NDT operators to interpret results.
- Discrete colors; white, red and blue
- Adjust «thumbs» to set transition depths.

- No transducer contact
- Delamination or disbonding
- Backwall reflection



Manual Stitching

- Easily covers large areas
- Follow defect edges, or pre-marked grid on surface, stitch in any direction
- Manual or automatic activation of next tile
- Variable tile overlap
- Tile adjustments
- Cross-tile measurements
- Accepted in Boeing 787 NDT Manual 51-00-20 Rev 30 Aug 2014.



What we are doing right now

What we are doing right now

- DolphiCam CF08 revision
- New DolphiCam CF16 announced!
- DolphiTech TeamCenter
- Remote NDT

CF08 gets a new dry coupling

- More robust
- Material depth 8mm
- Updated pulse calibration

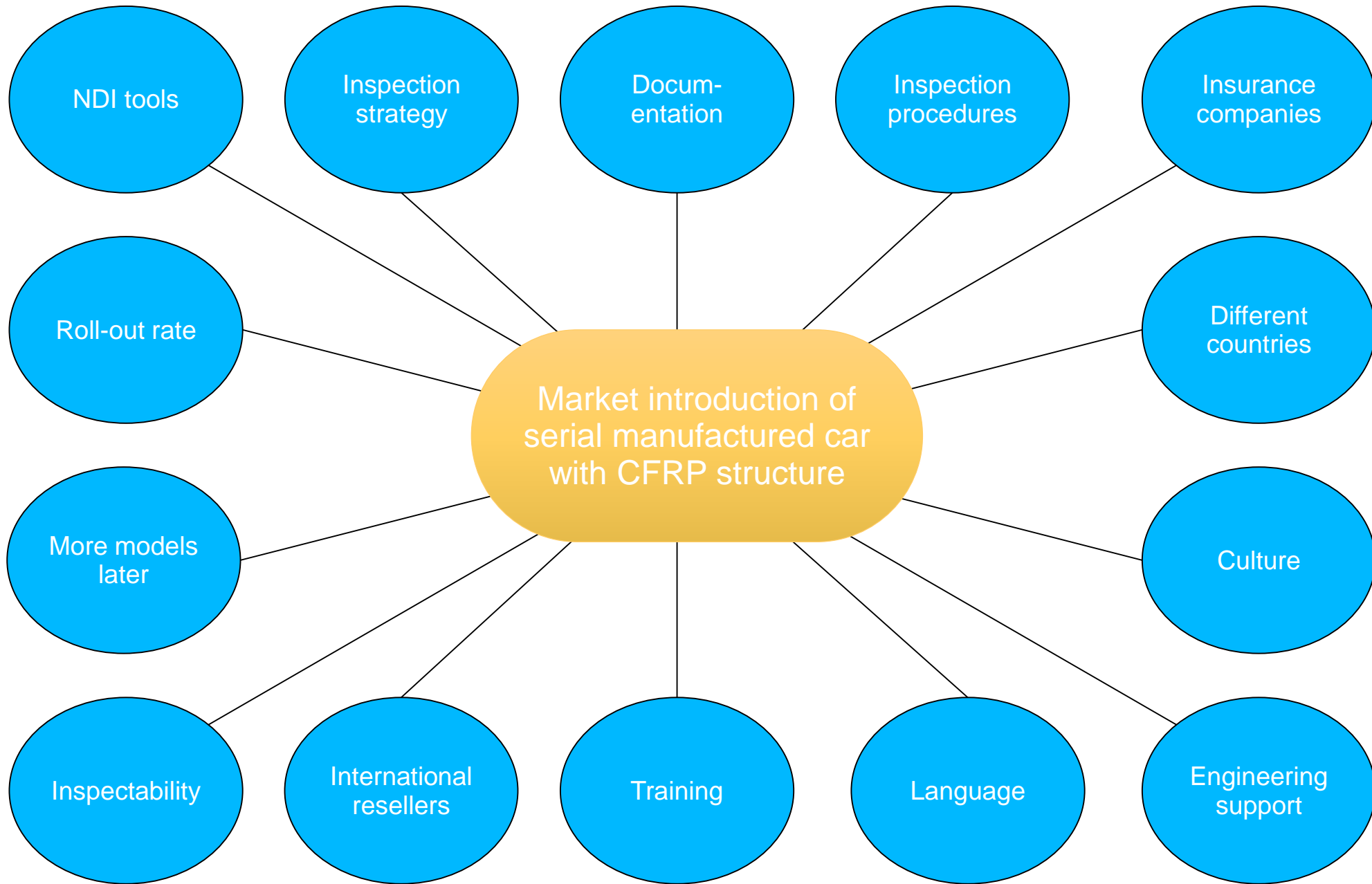


DolphiCam CF16 announced!

- Material depth 16 mm +
- Same SW & FW as CF08
- Offered separately, or bundled with the CF08

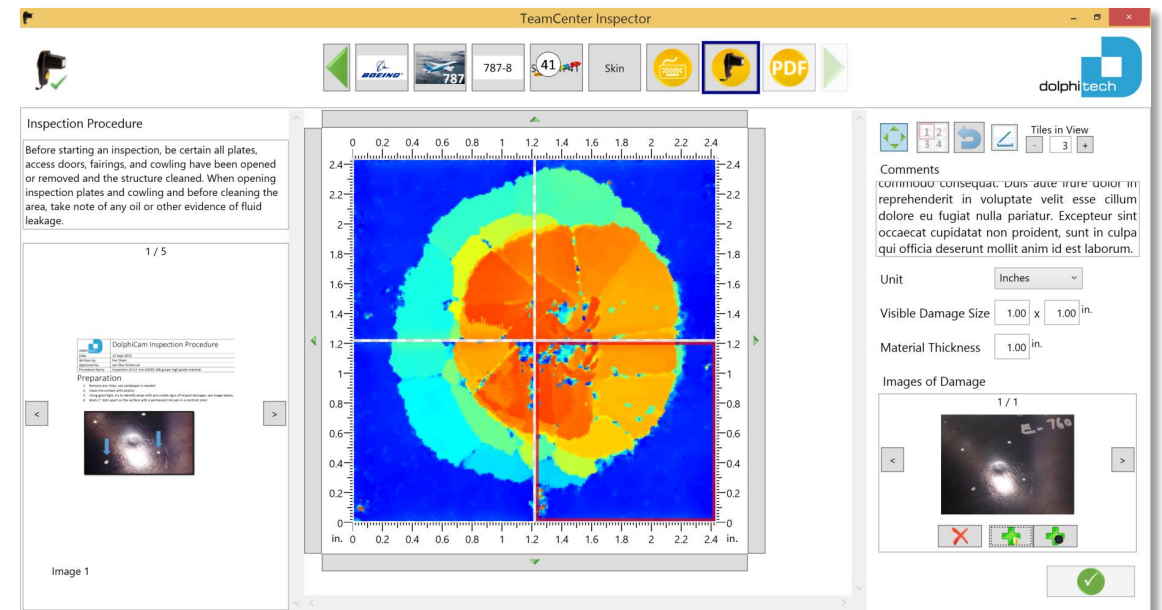


DolphiTech TeamCenter



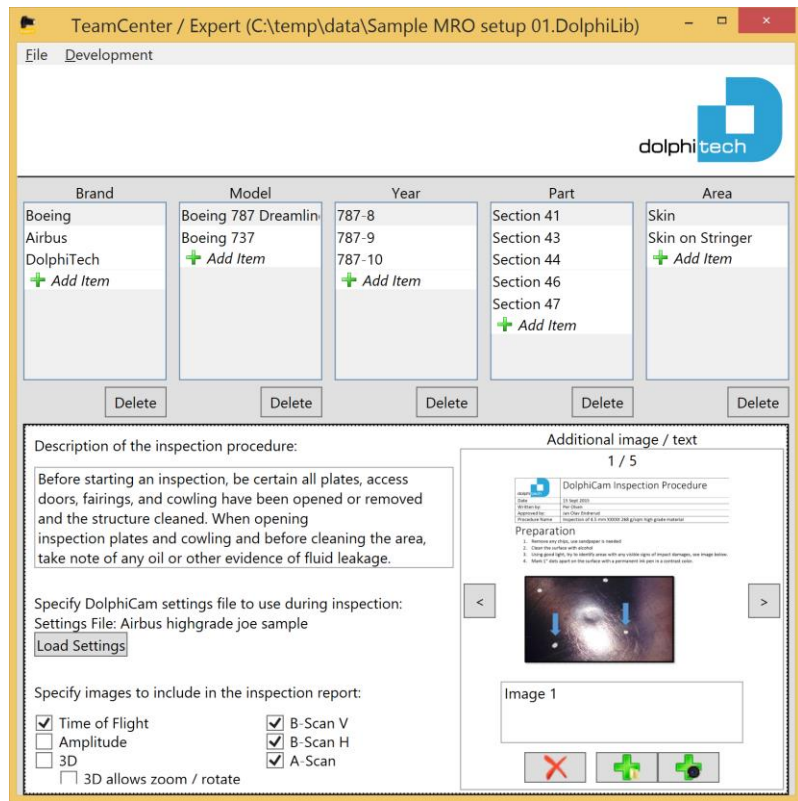
DolphiTech TeamCenter (1)

- Integrating DolphiCam with visual inspection procedures, guiding, documentation and automatic reporting
- Describe and embed expert knowledge in inspection procedure.
- Same equipment settings, every time.
- Add photos and webcam pictures.
- Automatic reporting.
- Designed for handheld Windows tablets.



DolphiTech TeamCenter (2)

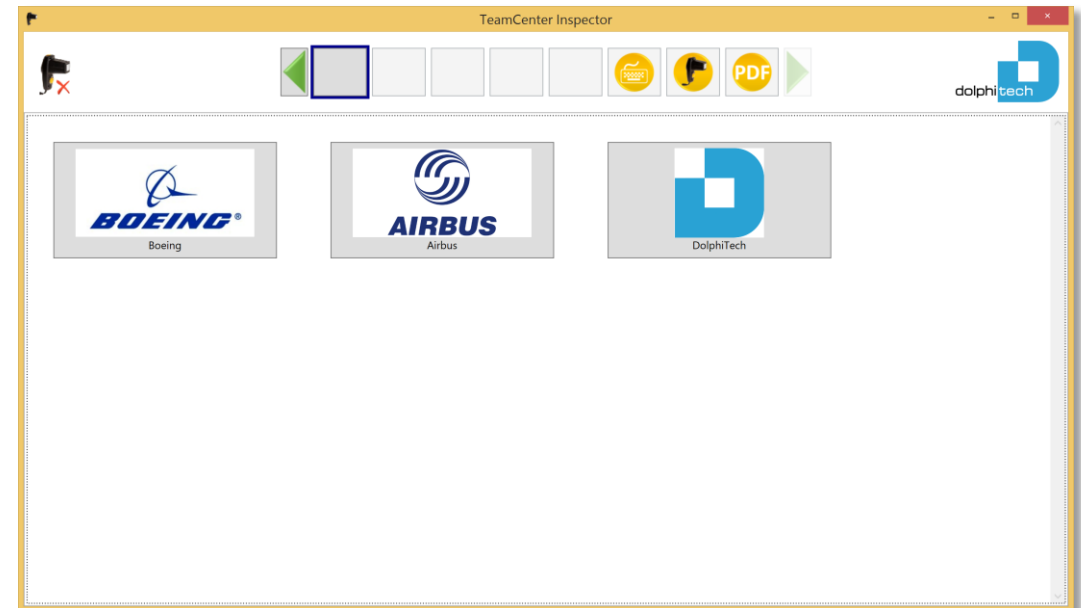
TeamCenter/Expert



TeamCenter Library

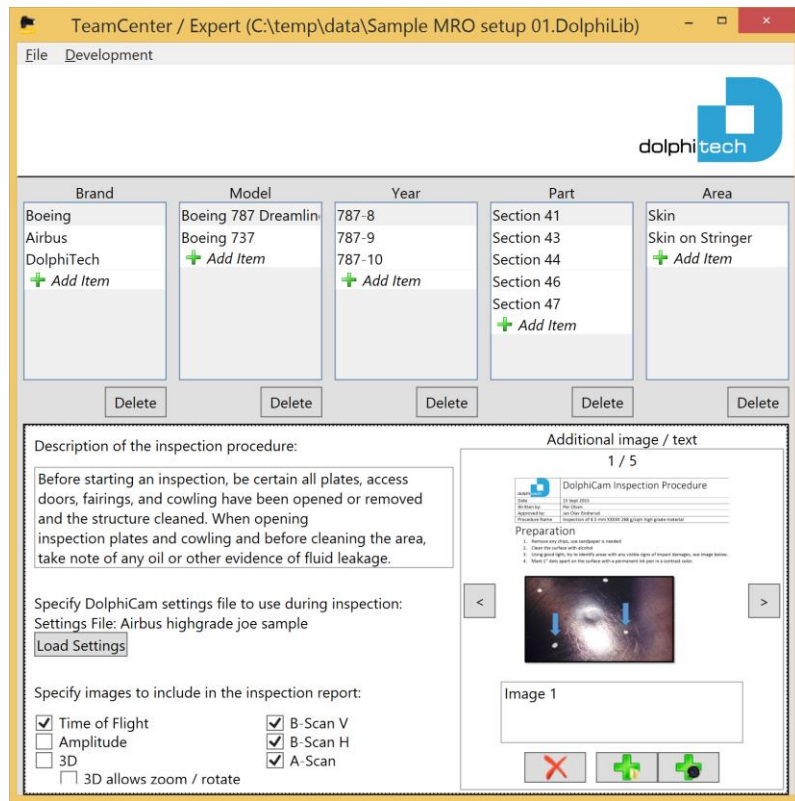


TeamCenter/Operator



DolphiTech TeamCenter (2)

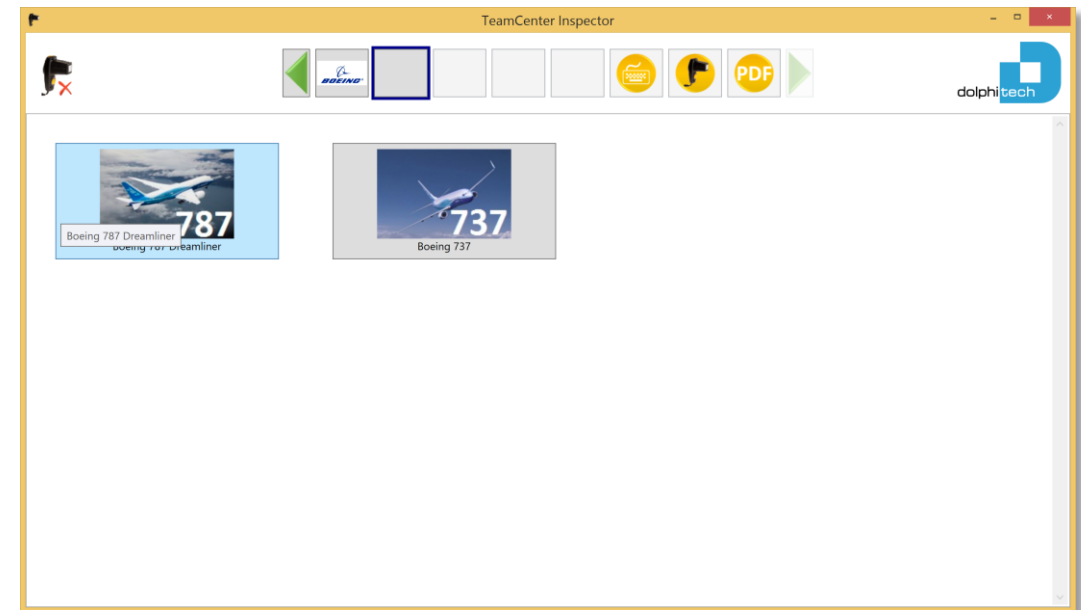
TeamCenter/Expert



TeamCenter
Library

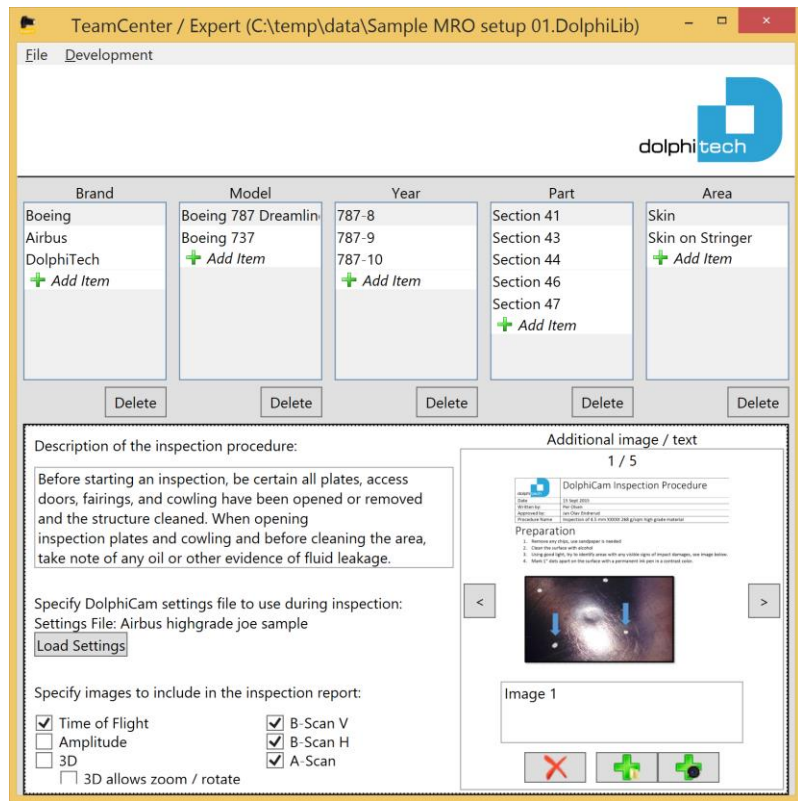


TeamCenter/Operator



DolphiTech TeamCenter (2)

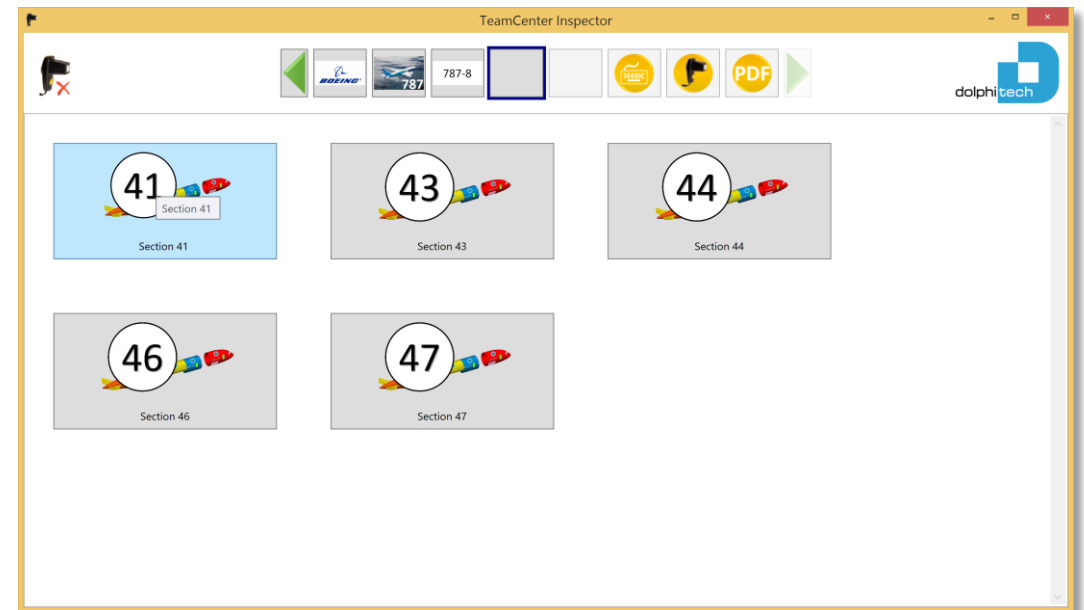
TeamCenter/Expert



TeamCenter
Library

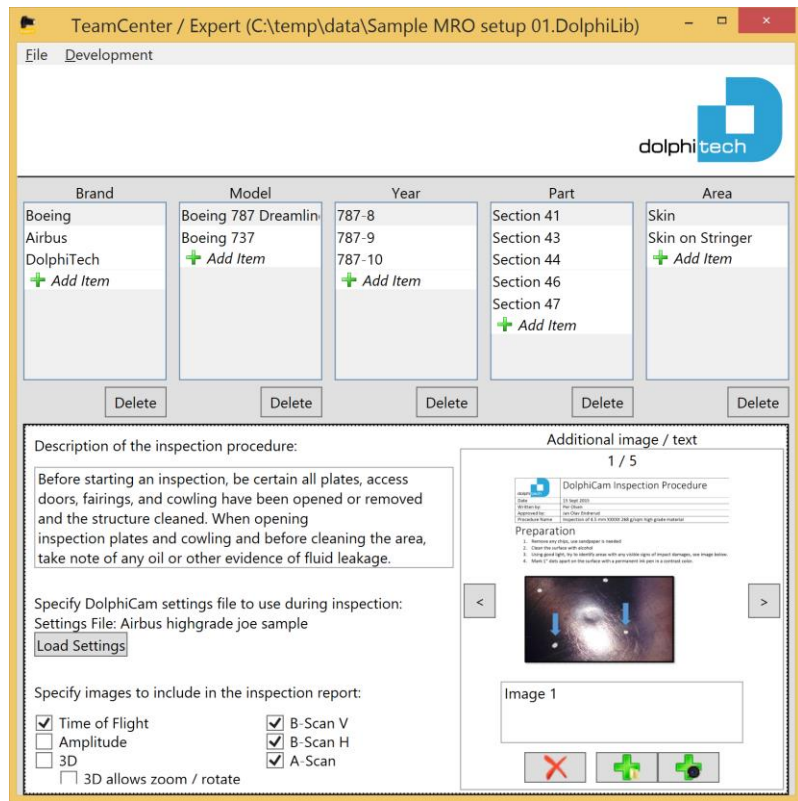


TeamCenter/Operator



DolphiTech TeamCenter (2)

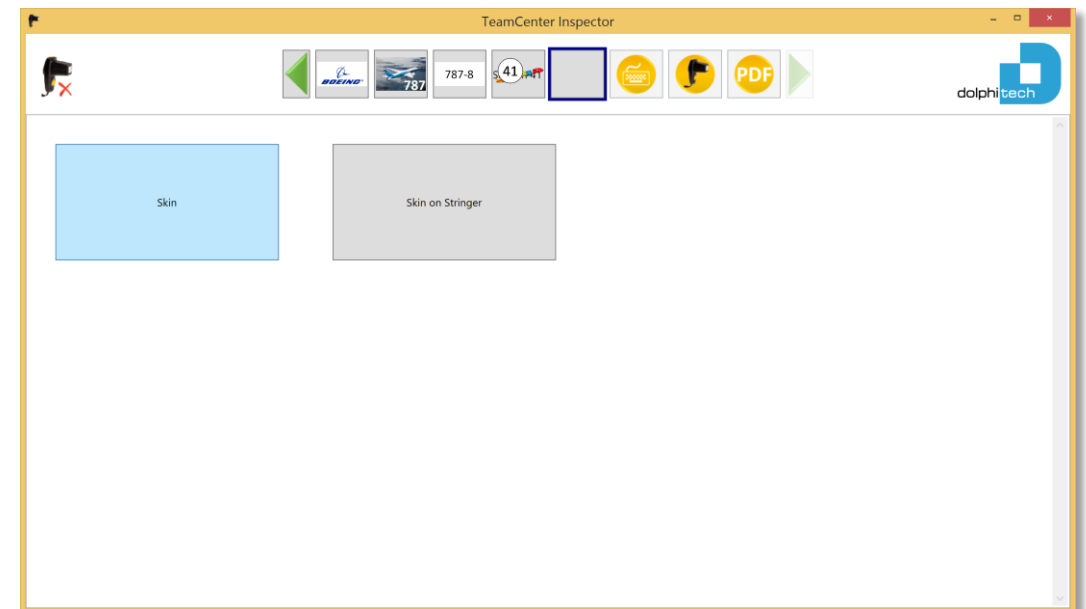
TeamCenter/Expert



TeamCenter
Library



TeamCenter/Operator



DolphiTech TeamCenter (2)

TeamCenter/Expert

TeamCenter / Expert (C:\temp\data\Sample MRO setup 01.DolphiLib)

File Development

dolphitech

Brand	Model	Year	Part	Area
Boeing	Boeing 787 Dreamlin	787-8	Section 41	Skin
Airbus	Boeing 737	787-9	Section 43	Skin on Stringer
DolphiTech	+ Add Item	787-10	Section 44	+ Add Item
		+ Add Item	Section 46	
			Section 47	+ Add Item

Buttons: Delete (under each column)

Description of the inspection procedure:
Before starting an inspection, be certain all plates, access doors, fairings, and cowling have been opened or removed and the structure cleaned. When opening inspection plates and cowling and before cleaning the area, take note of any oil or other evidence of fluid leakage.

Specify DolphiCam settings file to use during inspection:
Settings File: Airbus highgrade joe sample
Load Settings

Specify images to include in the inspection report:

<input checked="" type="checkbox"/> Time of Flight	<input checked="" type="checkbox"/> B-Scan V
<input type="checkbox"/> Amplitude	<input checked="" type="checkbox"/> B-Scan H
<input type="checkbox"/> 3D	<input checked="" type="checkbox"/> A-Scan

3D allows zoom / rotate

Additional image / text 1 / 5

DolphiCam Inspection Procedure

Preparation

Image 1

TeamCenter Library



TeamCenter/Operator

TeamCenter Inspector

dolphitech

MRO: Rorosfly

Worker ID: Ole Hansen

Repair Order Number: 2014-1234

Damage: Dent on left cargo door frame

Date of Damage: 9/22/2014

Reason for NDI: Dent on left cargo door frame

Serial number: B788-1234

Registration: LN-ABC

Owner: DolphiTech AS

Owner Address: Enggata 40, 2830 Raufoss, Norway

FLT HRS/Cycles: 234

MRO Comment: Lorem Ipsum

Images of Aircraft: 1 / 1

Buttons: Back, Forward, PDF, Save, Add, Remove

DolphiTech TeamCenter (2)

TeamCenter/Expert

TeamCenter / Expert (C:\temp\data\Sample MRO setup 01.DolphiLib)

File Development

dolphitech

Brand	Model	Year	Part	Area
Boeing	Boeing 787 Dreamlin	787-8	Section 41	Skin
Airbus	Boeing 737	787-9	Section 43	Skin on Stringer
DolphiTech	+ Add Item	787-10	Section 44	+ Add Item
		+ Add Item	Section 46	
			Section 47	+ Add Item

Buttons: Delete, Delete, Delete, Delete, Delete

Description of the inspection procedure:
Before starting an inspection, be certain all plates, access doors, fairings, and cowling have been opened or removed and the structure cleaned. When opening inspection plates and cowling and before cleaning the area, take note of any oil or other evidence of fluid leakage.

Specify DolphiCam settings file to use during inspection:
Settings File: Airbus highgrade joe sample
Load Settings

Specify images to include in the inspection report:
 Time of Flight
 Amplitude
 3D
 3D allows zoom / rotate
 B-Scan V
 B-Scan H
 A-Scan

Additional image / text
1 / 5
DolphiCam Inspection Procedure
Preparation
Image 1

TeamCenter
Library



TeamCenter/Operator

TeamCenter Inspector

Inspection Procedure
Before starting an inspection, be certain all plates, access doors, fairings, and cowling have been opened or removed and the structure cleaned. When opening inspection plates and cowling and before cleaning the area, take note of any oil or other evidence of fluid leakage.

1 / 5

DolphiCam Inspection Procedure
Preparation

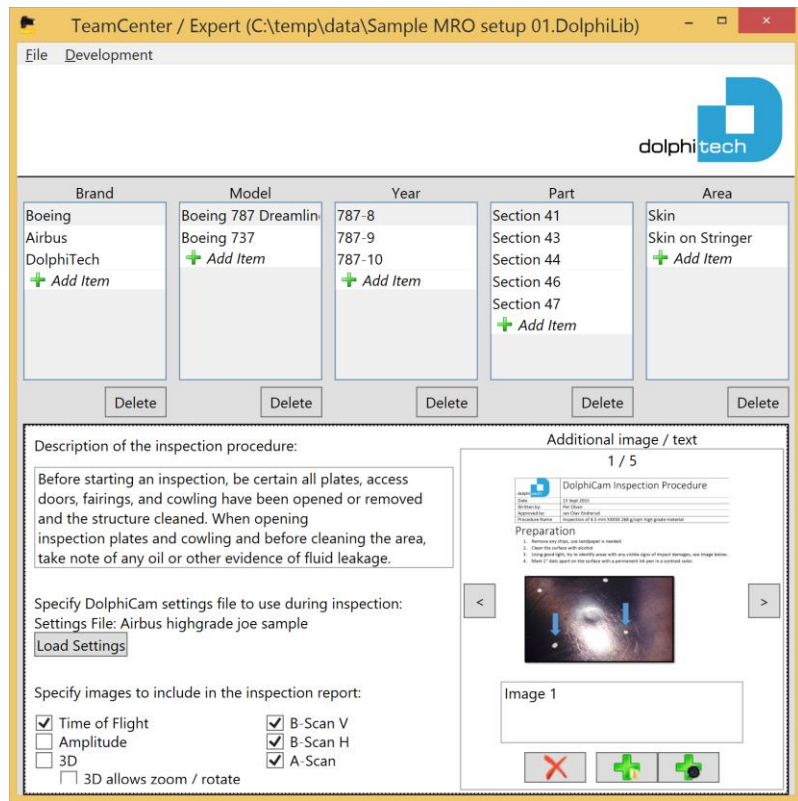
Image 1

Unit: Inches
Visible Damage Size: 1.00 x 1.00 in.
Material Thickness: 1.00 in.

Images of Damage
1 / 1
E = 760

DolphiTech TeamCenter (2)

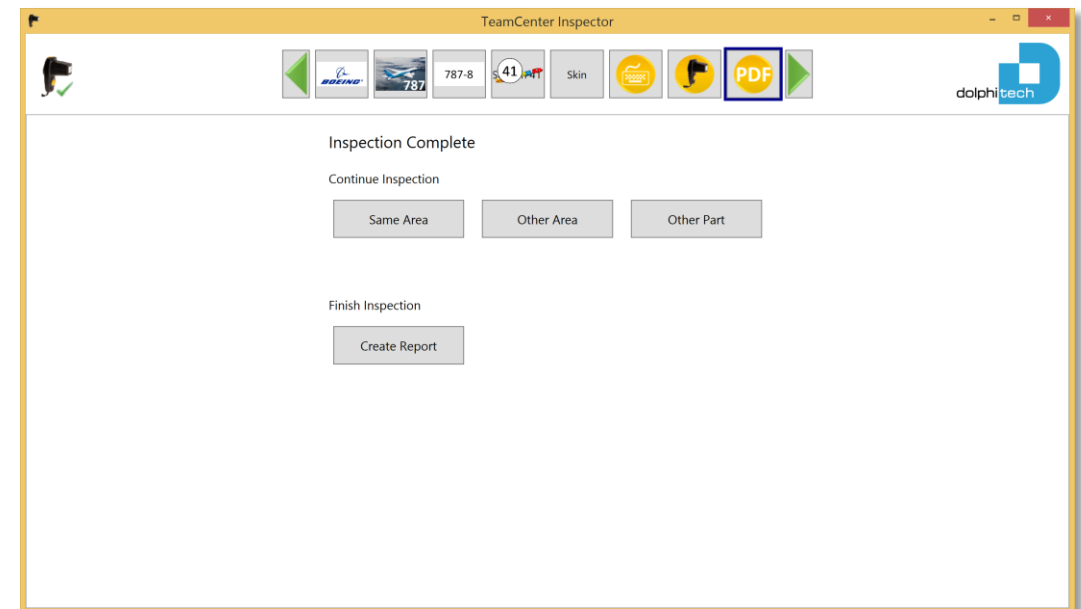
TeamCenter/Expert



TeamCenter
Library

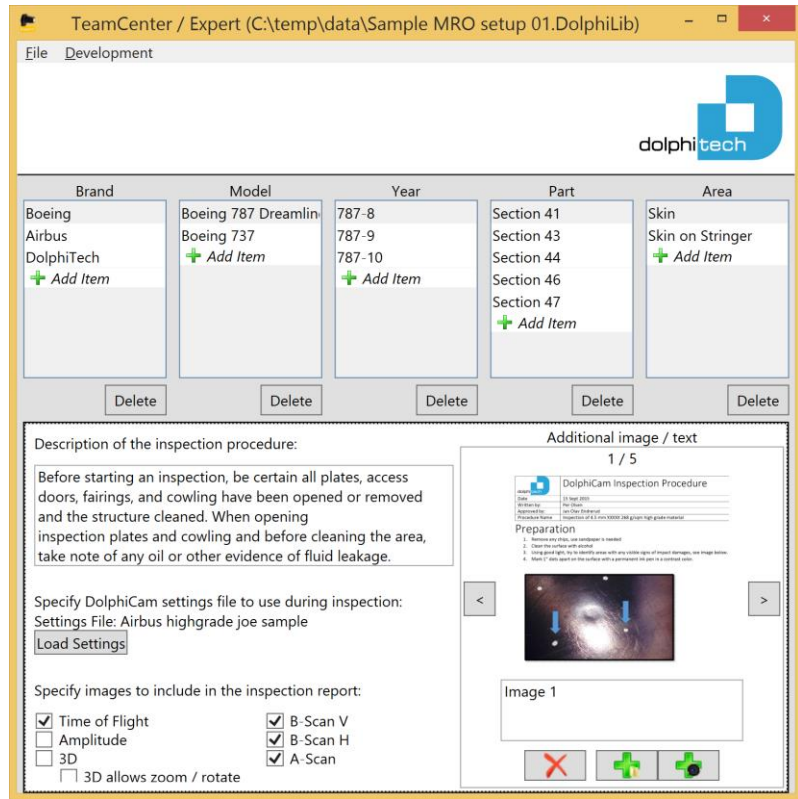


TeamCenter/Operator



DolphiTech TeamCenter (2)

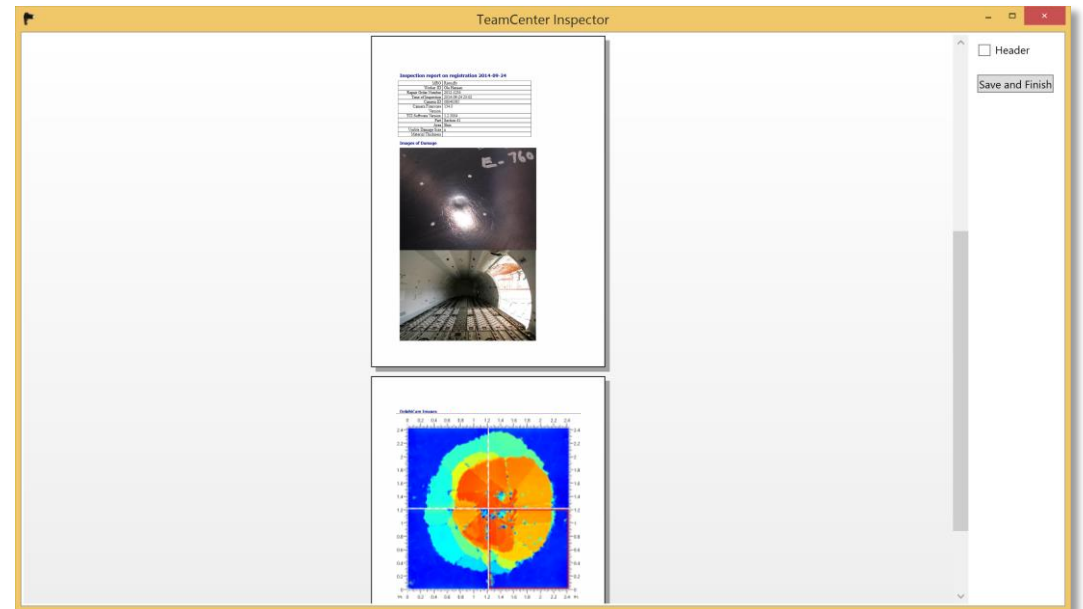
TeamCenter/Expert



TeamCenter
Library



TeamCenter/Operator



DolphiTech TeamCenter (3)

The screenshot displays the TeamCenter Inspector application window. At the top, the title bar reads "TeamCenter Inspector". Below it is a navigation path bar containing icons for "BOEING", "787", "787-8", "41", "Skin", a selected icon of a person, and "PDF". The main interface is divided into several sections:

- Navigation path:** A yellow callout box points to the top navigation bar.
- Inspection Procedure:** A text box on the left provides instructions: "Before starting an inspection, be certain all plates, access doors, fairings, and cowlings have been opened or removed and the structure cleaned. When opening inspection plates and cowlings and before cleaning the area, take note of any oil or other evidence of fluid leakage." Below this is a "Preparation" section with a small image labeled "Image 1".
- Zoomable:** A yellow callout box points to the zoom controls on the left side of the main image.
- Stitch mode control:** A yellow callout box points to the "Stitch" icon in the top navigation bar.
- Switch units:** A yellow callout box points to the "Unit" dropdown menu in the right-hand panel, which is currently set to "Inches".
- Webcam support:** A yellow callout box points to the "Images of Damage" section in the right-hand panel, which shows a small image labeled "1/1" with a handwritten "E-760" and a green checkmark below it.

The central part of the interface features a large, circular, multi-colored heatmap representing an inspection area, with axes ranging from 0 to 2.0. The right-hand panel includes a "Comments" section with placeholder text, a "Visible Damage Size" field set to "1.00 x 1.00 in.", and a "Material Thickness" field set to "1.00 in.". The bottom right corner of the interface has a green checkmark icon.

DolphiTech TeamCenter (4)

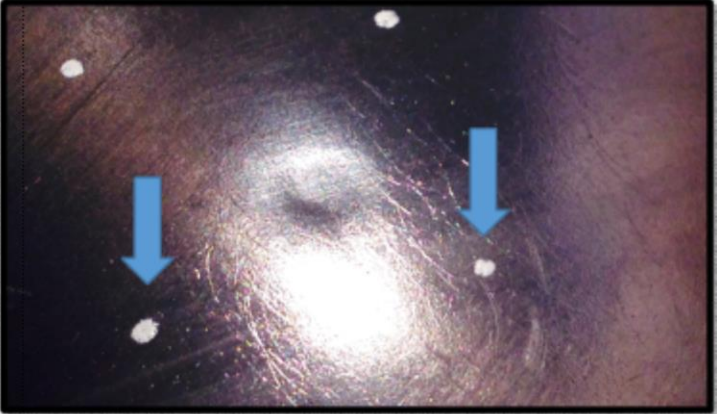
TeamCenter Inspector

DolphiCam Inspection Procedure

Date	15 Sept 2015
Written by:	Per Olsen
Approved by:	Jan Olav Endrerud
Procedure Name	Inspection of 4.5 mm XXXXX 268 g/sqm high grade material

Preparation

1. Remove any chips, use sandpaper is needed
2. Clean the surface with alcohol
3. Using good light, try to identify areas with any visible signs of impact damages, see image below.
4. Mark 1" dots apart on the surface with a permanent ink pen in a contrast color.



1 / 5

Image 1

Damage Size x mm

Material Thickness mm

Types of Damage

✕ + + ✓

DolphiTech TeamCenter (5)

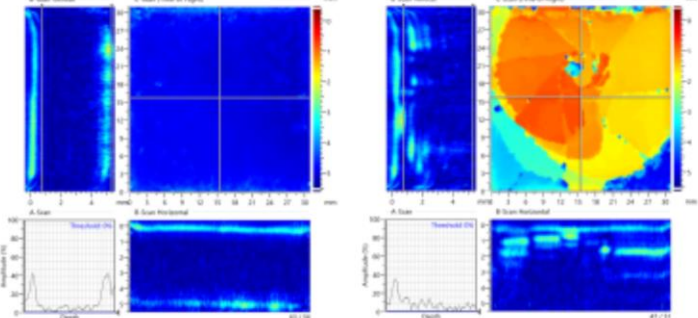
TeamCenter Inspector

DolphiCam Inspection Procedure

Date	15 Sept 2015
Written by:	Per Olsen
Approved by:	Jan Olav Endrerud
Procedure Name	Inspection of 4.5 mm XXXXX 268 g/sqm high grade material

Inspection

1. Add water or contact gel
2. Position the camera onto the top, left marking indicator, using the indicator line on the camera
3. Verify good contact in the screen image.
4. Freeze the image using the camera button.
5. Move to the next marker. Repeat from 2.
6. Complete all the tiles
7. When complete, add the Comments, visible damage size fields on the left side
8. Add Pictures as needed.
9. Press "Next".
10. Create the PDF report, or perform another inspection as needed.



Undamaged material

Impact damage

Inspection Procedure

Before starting an inspection, be certain all plates, access doors, fairings, and cowling have been opened or removed and the structure cleaned. When opening inspection plates and cowling and before cleaning the area, take note of any oil or other evidence of fluid leakage.

4 / 5

Image 4

Comments

Unit: Millimeters

Visible Damage Size: x mm

Material Thickness: mm

Images of Damage

What we will be doing next

Remote NDT

Term

Traditional NDT

A certified inspector performs an inspection of an object on-site according to a inspection procedure.

Remote NDT

A certified inspector performs an inspection of a remotely located object, according to an inspection procedure, with the assistance of one or more helpers at the site of the object, and aided by realtime video-, sound- and NDT data transferred over a communication channel.

Simplified NDT

An individual with necessary training performs an inspection with the use of a procedure, supporting technology and clearly defined acceptance criterias.

Expected market development

Traditional NDT + R&D market develops with CFRP use.

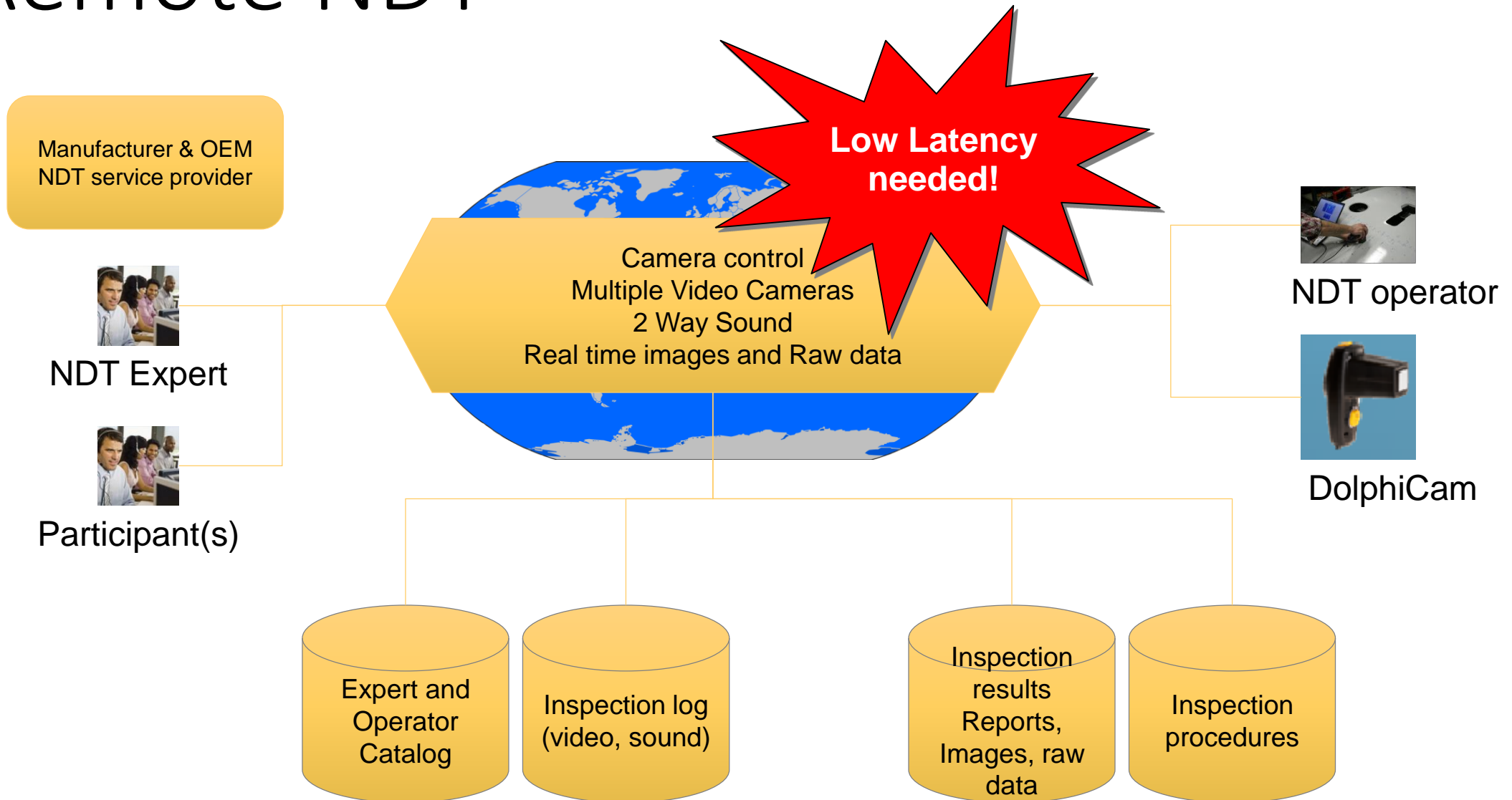
Manufacturing

- Quick check tool for borehole inspection, bond testing, accidental damages
- Inline manufacturing: will be low volume, tailored, project delivery and needs a dedicated business model.

Remote and Simplified NDT scales with

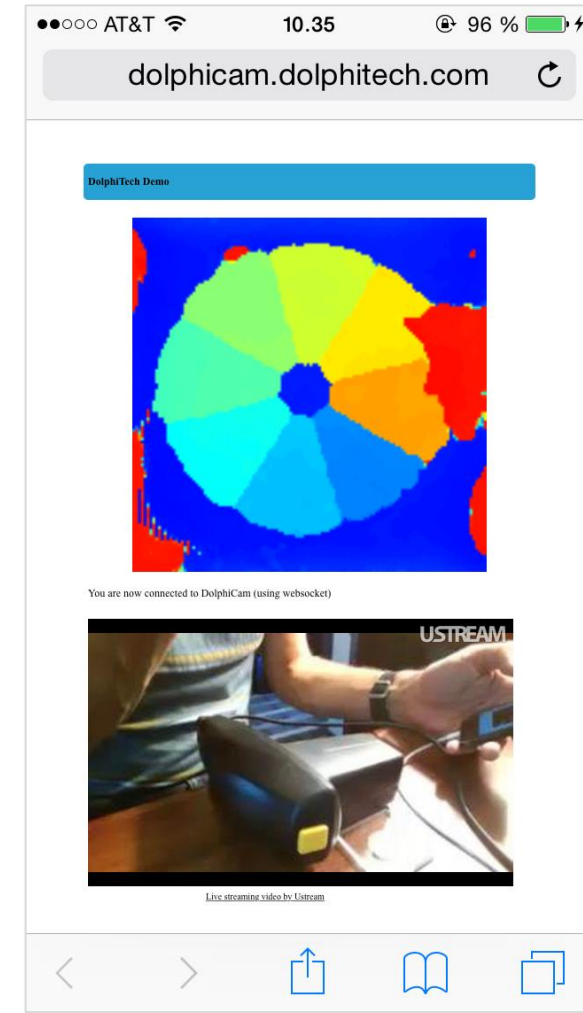
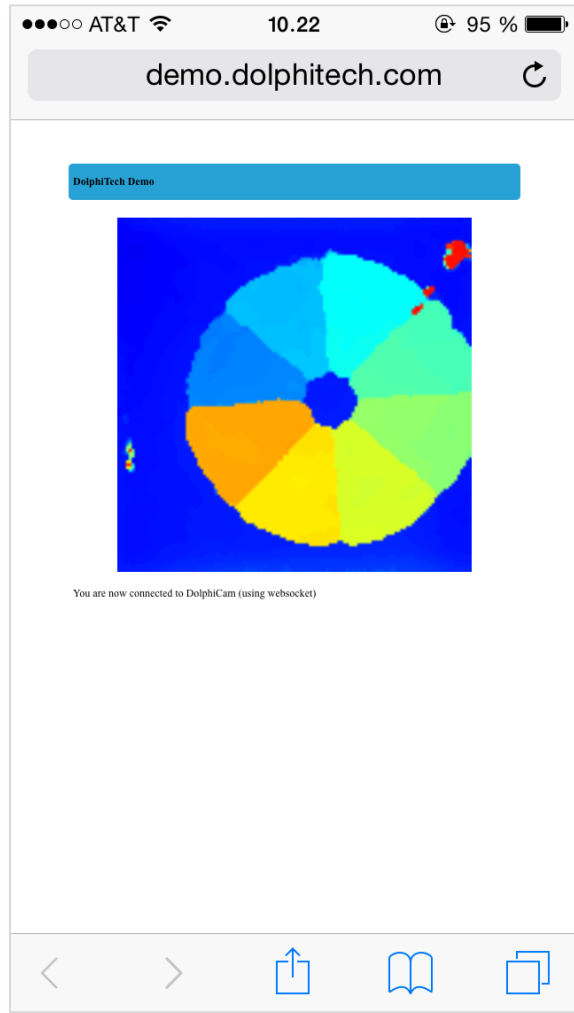
- Cost focus; salaries, training, travel and equipment
- Rollout of planned cars/aircraft
- Increasing level of integration between manufacturers, maintenance organizations and service providers.
- Regulatory changes

Remote NDT

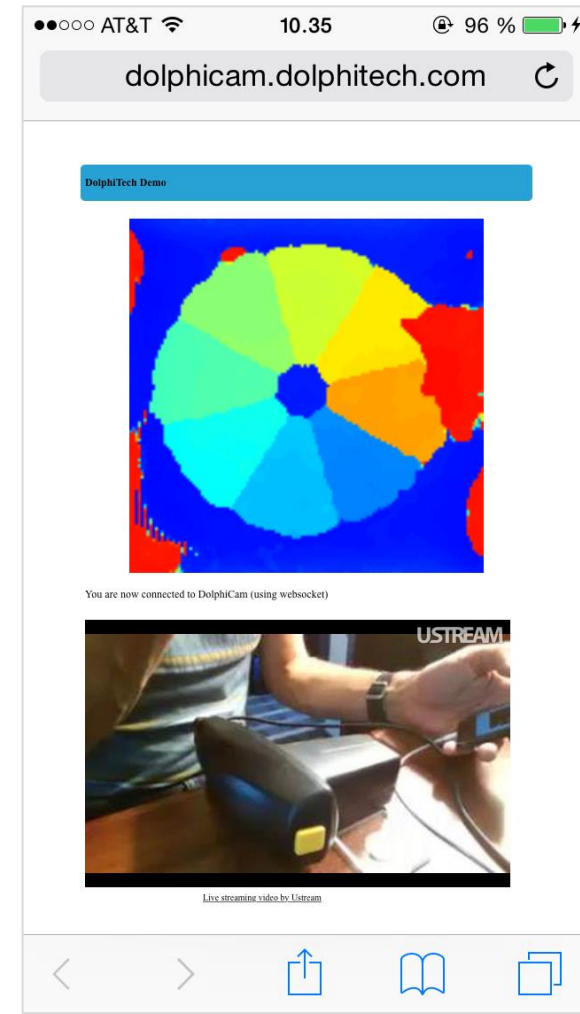
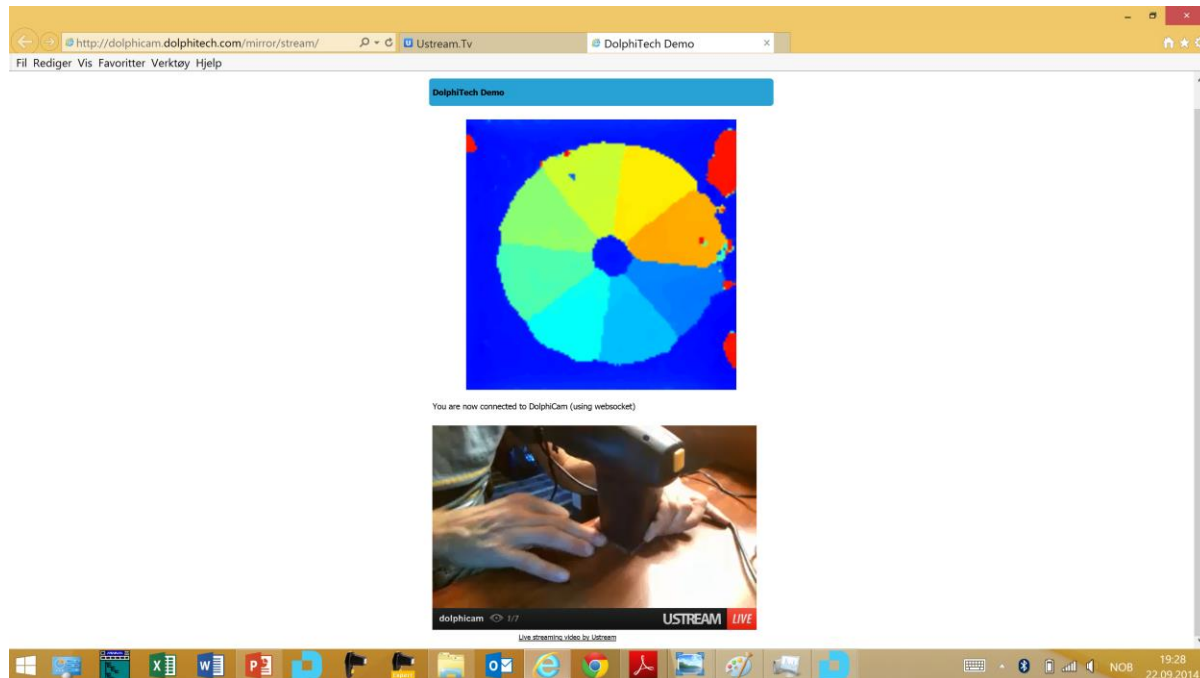


bit.ly/rndt2

View, control and monitor



...on any device



Thank you for your
attention!

www.dolphitech.com