Continuous Health Monitoring And Non Destructive Assessment Of Composites And Composite Repairs On Surface Transport Applications
Grant agreement: 218697

Automatic Thermographic Image Defect Detection in Composites

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Presenter: SP Santospirito, Program Manager
The work has been partly funded by the European Union’s FP7 program in which 11 organisations from 6 EU countries have collaborated in the ComPair project.
Here's a Problem: Humans are clever

Greetings Humans!
I come in peace.
Take me to your Leader!

Compliments of FLIR: emmanuel.vanneau@flir.com
SPIE Symposium, Orlando April 2011
Here’s a Problem: Humans are clever

But this is trickier!
The ComPair software uses the KCC Sentence suite to deliver an end-to-end, user friendly platform for engineers to perform complete manual inspections of pulsed thermography and near IR images of composite materials -

as well as tools that allow senior engineers to develop inspection templates and profiles, reducing the requisite thermographic skill level of the operating engineer.

The ComPair software can also offer complete independence of operator decisions by the fully automated “Beep on Defect” detection functionality.
KCC Sentence Modules for ComPair:

Inspection Object
Inspection System
Inspection Standard

Management of inspection hardware (robot arm and thermographic cameras)
Management of data acquisition (image restitching)
Analysis and Sentence
Core Functionalities

The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:
- Inspection Object
Inspection System
Profile Management
Display Profile Details

Display Profile Graphically
Core Functionalities

The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:
- Inspection Object
- Inspection System
Define Inspection System
The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:
- Inspection Object
- Inspection System
- Inspection Standard
Import Standards
### Standards

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<th>No.</th>
<th>Parameter</th>
<th>Operation</th>
<th>Percent [%] A</th>
<th>Parameter A</th>
<th>Percent [%] B</th>
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<td>Panel Area</td>
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The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:
- Inspection Object
- Inspection System
- Inspection Standard
- Management of inspection hardware: Robot Arm
Generate Robot Arm Positions
The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:
- Inspection Object
- Inspection System
- Inspection Standard
- Management of inspection hardware: Thermographic Cameras
Inspection procedure and progress
Short Video
The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:

- Inspection Object
- Inspection System
- Inspection Standard
- Management of inspection hardware
- **Management of data acquisition:** Compiling the total image from sections (Image Stitching)
The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:
- Inspection Object
- Inspection System
- Inspection Standard
- Management of inspection hardware
- Management of data acquisition
- Analysis
Defect Quantification, Measurement and Sentencing

Manual Detection option

Automatic Detection option

Define System
Robt Arm
Standards
Inspect
Image Stitch
Sentence

Live Video Preview

Manual Detection  Automated Detection  Full Width Half Maximum

Sentence Image  Clear Inspection

Defects Detected: 0

Sentence Minimum Size in Pixels [0 - 400000] 5
Defect Maximum Size in Pixels [0 - 400000] 300
Beep on defect  Invert Threshold Operation

Load image  Save image

Finish
Possible Defects

Engineer Determines Defect Target Range

Reported Defects

Possible Defects
Automatic Detection: Raw Greyscale Image

Raw Greyscale Image
Raw Greyscale Image presented as greyscale frequency histogram.
Determination of Background Undefected Composite Raw Greyscale Image with modal value and Gaussian distribution identifies background Greyscale pixels outside 3 Sigma range represent Regions of Interest (ROI)
Automatically sets Target Range

Automatically Detected Defects Numbers
FWHM - Quantification
Analyses each and every line profile for FMHM variations outside the normal range i.e., identifies defects.
Presents Line Profile of MAXIMUM FWHM

Maximum FWHM used in Sentence
The KCC Sentence Suite provides an end-to-end software framework and workflow structure to support NDT inspections, independent of inspection object, system and standard.

KCC Sentence Modules:
- Inspection Object
- Inspection System
- Inspection Standard
- Management of inspection hardware
- Management of data acquisition
- Analysis and
- Sentence
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Customisation of panel inspection system.
Depends on End user testing: Requirement elucidation / usability enhancement

The agreement on a standard:
selection of key sentencing parameters and proposing acceptance criteria

Functionality questions:
Real Time? Temporal line profiles
Can we link contiguous pixels to standards?
How do we deal with close but non-contiguous defects?
More definitive characterisation of defects?
AI / neural networks and training?