Computer-aided analysis of ultrasound data to speed-up the release of aerospace CFRP components

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(1) EADS Innovation Works
(2) NDT EXPERT
(3) ANDTc
EADS at a glance
## EADS Innovation Works overview

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<td>A centre dedicated to develop advanced light and robust materials and processes applicable to new products.</td>
<td>A centre dedicated to develop cost efficient, light, reliable and environmental friendly surface treatments, metallic/hybrid structures and associated intelligent production routes.</td>
<td>A centre dedicated to engineering of processes in the design and manufacture of advanced crossing mechanics, electronics and IT expertises.</td>
<td>A centre specialized in development and integration of sensor, communication and avionic systems to enable functional and operational improvements in safety &amp; security, autonomy, availability and efficiency.</td>
<td>A centre dedicated to improving the quality of chain of value from initial design to after sales follow-up, by means of simulation and virtual architecture enhanced by IT technologies.</td>
<td>A centre dedicated to new energy and propulsion technologies, and the related architecture, anticipating future regulations &amp; economical trends.</td>
<td>A centre dedicated to identifying new technologies for future and competitive products and defining the associated roadmaps with each division by means of concept-demonstrators.</td>
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NDT EXPERT & ANDTc overview

NDT EXPERT FRANCE
Since 1991
European Economic Interest Group

African NDT Centre
South Africa
Private company ltd Since 2003
Content

1. Introduction

2. Most original tools for composites evaluation

3. Application to various components

4. Conclusions & continuation
1. **Introduction**
   4 reasons to develop new analysis tools dedicated to CFRP

1. **Increasing utilization of CFRP** in aircraft structures to save weight & thereby reduce fuel burn

2. **NDT is mandatory** for these materials as the current manufacturing processes cannot assure flawless structures

3. The processing of ultrasound data can create a manufacturing **cycle bottleneck**

4. The many **different files formats** & data readers (none including analysis tools fully compliant with the methodology & the acceptance criteria defined by AIRBUS & flowed down to the supply chain)
1. Introduction
Background & current status

• **Background**: since 2004, EADS IW was sponsored by AIRBUS in developing dedicated analysis software

• **Objective**: help operators to focus their attention only on areas of suspicion

• **Packaging**: included in & software (commercial version distributed by NDT EXPERT)

• **Maturity**: used on a daily basis to inspect many EADS Products and Platforms now including the A350XWB aircraft...

Scanning machine for A350 wing covers
Content

1. Introduction

2. Most original tools for composites evaluation
   2.1. Detection of foreign bodies & delaminations
   2.2. Porosity content estimation
   2.3. Thickness measurements

3. Application to various components

4. Conclusions & continuation
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.1 For constant thickness areas: palette compressing (1/4)

Computer-aided analysis of ultrasound data to speed-up the release of aerospace CFRP components
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.1 For constant thickness areas: palette compressing (2/4)

Compressed palette
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.1 For constant thickness areas: palette compressing (3/4)

Automatic detection => list of discontinuities
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.1 For constant thickness areas: palette compressing (4/4)
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.2 For changing thickness areas: BWE filtering (1/4)

Computer-aided analysis of ultrasound data to speed-up the release of aerospace CFRP components
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.2 For changing thickness areas: BWE filtering (2/4)

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ToF C-scan after BWE filtering
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.2 For changing thickness areas: BWE filtering (3/4)
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.2 For changing thickness areas: BWE filtering (4/4)

Manual reduction of the list of discontinuities
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.3 For changing thickness areas: C-Scan subtraction

(a) raw C-scan to be analyzed

(b) reference C-scan

(c = a - b) subtracted C-scan

Zoomed subtracted C-scan
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.4 For edges (1/3): masking

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2.1. Detection of foreign bodies & delaminations

2.1.4 For edges (2/3): Edge Effect Correction

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2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.4 For edges (3/3): automated edge detection
2. Most original tools for composites evaluation

2.1. Detection of foreign bodies & delaminations

2.1.5 Drilled holes

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2. Most original tools for composites evaluation

2.2. Evaluation of porosity content

2.2.1 Graphs amplitude attenuation (dB) vs thickness (mm)

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2. Most original tools for composites evaluation

2.2. Evaluation of porosity content

2.2.2 Filter Technique for Porosity Evaluation

Transducer signal & Attenuation curves = Processed porosity rate (%) C-scan
2. Most original tools for composites evaluation

2.2. Thickness measurements

Automatic extraction for all the points

Possible export to XLS file
Content

1. Introduction

2. Most original tools for composites evaluation

3. Application to various components
   3.1. Prototype or first components
   3.2. Serial components

4. Conclusions & continuation
3. Application to various components

3.1. Prototype or first components

3.1.1 Processing A-scans

Computer-aided analysis of ultrasound data to speed-up the release of aerospace CFRP components
3. Application to various components
   3.1. Prototype or first components

3.1.2 C-scans merging

Computer-aided analysis of ultrasound data to speed-up the release of aerospace CFRP components
3. Application to various components

3.2. Serial components

Automatic processing & reporting

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4. Conclusions & continuation
4. Conclusions & continuation

• **Output**: successful developed dedicated analysis software for the 3 steps of ultrasound data of CFRP:
  - Detection of foreign bodies & delaminations
  - Porosity content estimation
  - Thickness measurements

• **Deployment** of **NDT** at AIRBUS:
  - A380 Centre Wing Box: time savings reductions > 70%
  - A350: qualified harmonized tools for all components, fully compatible with AITMs standards

• **Deployment** of **ultiS** outside EADS: many subcontractors convinced by the flexibility of the tools which can be customized
4. Conclusions & continuation

- **Continuation (1/2):** possibilities to load data acquired with other techniques (e.g. Penetrant Testing, InfraRed Thermography, X-Ray Testing, Eddy Current Testing; etc.)
4. Conclusions & continuation

• **Continuation (2/2):** run ultis as an invisible task with **Smart NDT tools** instruments, to get immediate diagnosis results (e.g. automatic sizing of defects, thickness measurements, etc.)
Acknowledgements

Many thanks to

• All our **EADS colleagues**, especially those from AIRBUS, who use NDT kit on a daily basis. Their requirements and feedback made it possible for Ultis to become a commercial success outside of EADS Group.

• **You** for your attention & your upcoming questions

• Welcome to stand #23 (ANDTc) for more information about

• Contact: contact@ndt-expert.fr

• Forum: [http://ndt-expert.xooit.fr/f6-ULTIS.htm](http://ndt-expert.xooit.fr/f6-ULTIS.htm)