PROJECT OVERVIEW AISHA II

DETECTION OF CORROSIVE AND HYDRAULIC LIQUIDS BY GAUGES BASED ON THE COLLAPSE OF PERCOLATION CONDUCTIVITY - Basic concept and applications

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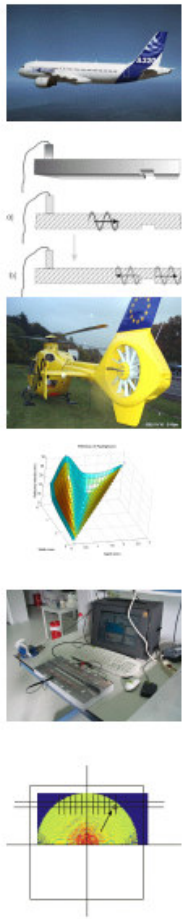
Department of Metallurgy and Materials Engineering (MTM)

[2)] Lufthansa Technik AG, Rhein Main Airport
60546 Frankfurt/Main, Germany

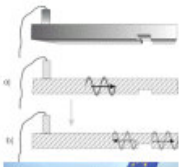
DATE:
October 8, 2010

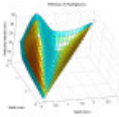
PLACE:
EASN Workshop - Paris

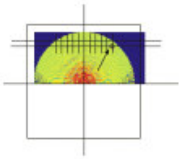


AISHA II
EU- FP7 - CP 212912

AIRCRAFT INTEGRATED STRUCTURAL HEALTH ASSESSMENT II (2008-2011)







METALogic

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RTU

VRIJE UNIVERSITEIT BRUSSEL · SCIENTIA VINCERE TENEBRAS ·

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CTA

InSensor A/S

CEDRAT TECHNOLOGIES

Fraunhofer IFAM Institut Fertigungstechnik Materialforschung

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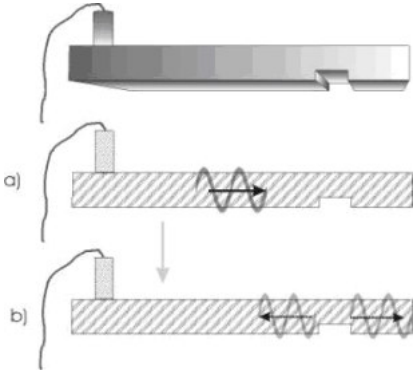
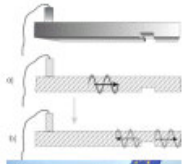
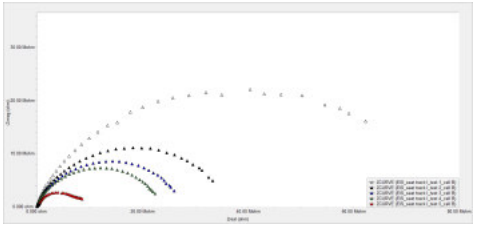
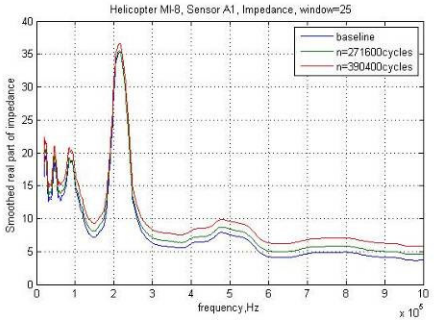

a)
b)



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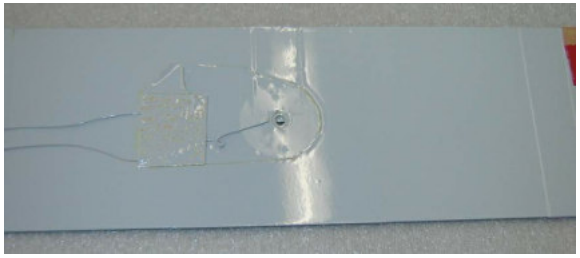
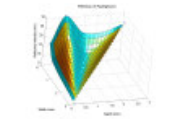
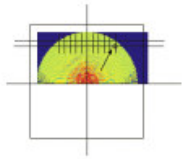
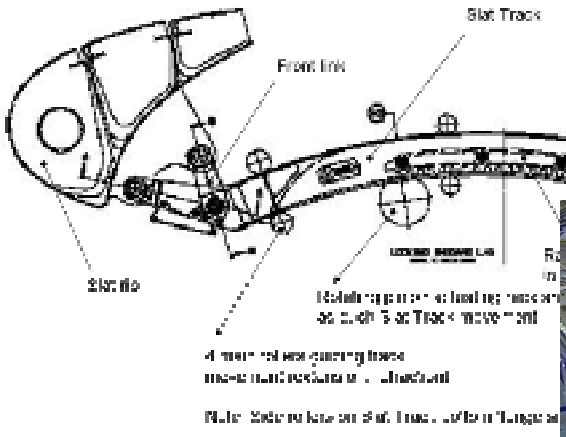
n=390400cycles
Smoothed real part of impedance
frequency,Hz
x 10^6

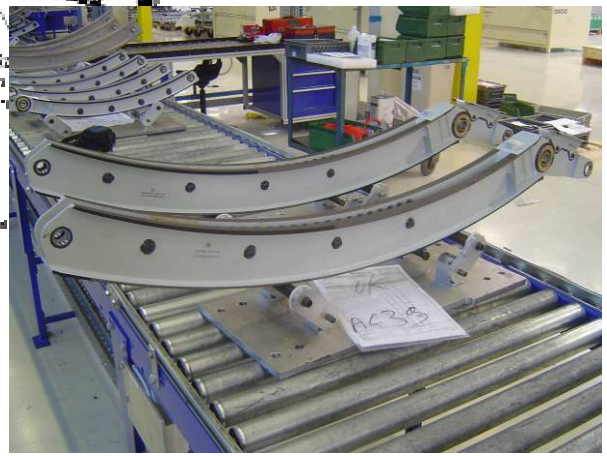


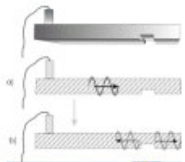


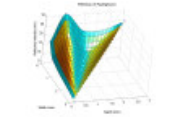


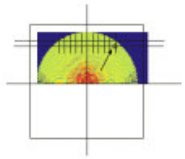
1/5 Slat Tracks - Airbus A 320 – A380 - Fatigue crack monitoring











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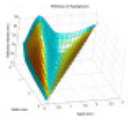
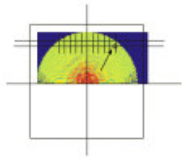
2/5 Tailboom - EC 135 – Impact damage





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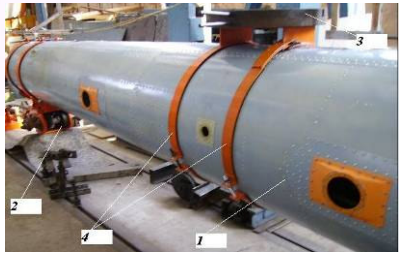
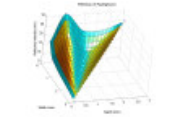
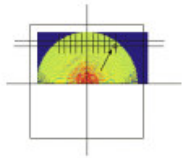
3/5 Tailboom - Mil 8 – Fatigue cracks







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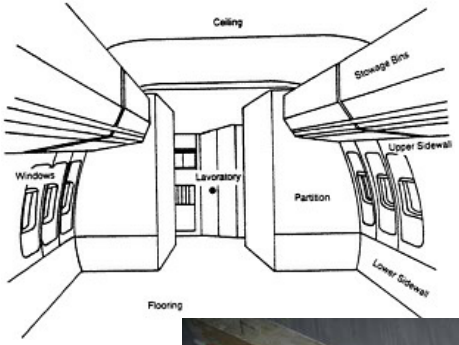
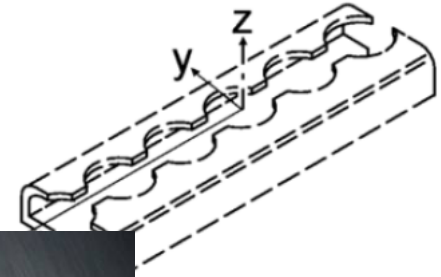
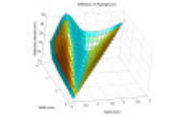
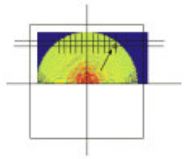
4/5 Floorbeam/Seat tracks - corrosion prevention and detection

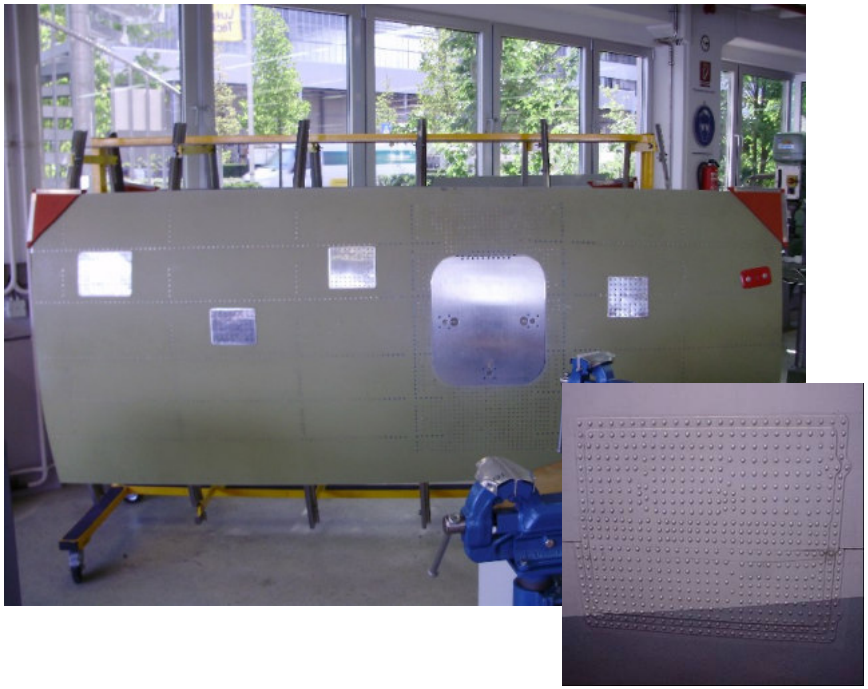


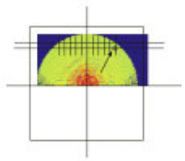




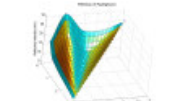


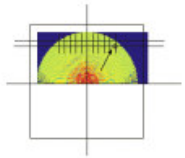
5/5 Doubler repairs - Fatigue cracks in critical rivet rows



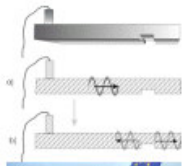


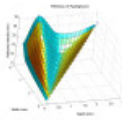
Floor beam – corrosion prevention

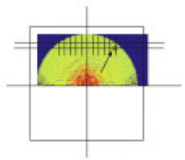




PLAN B



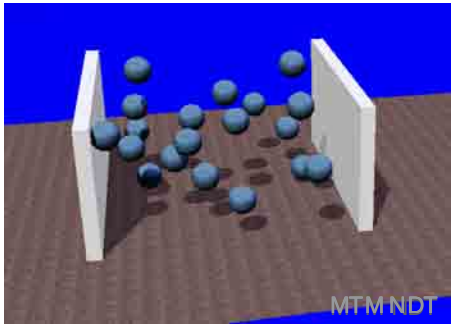


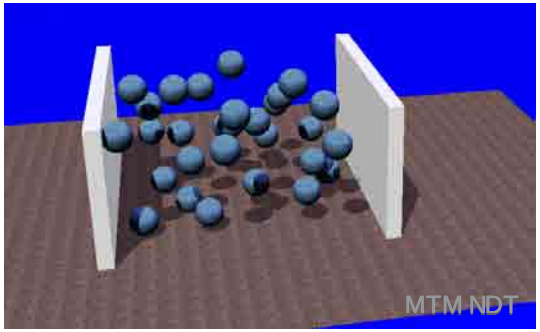


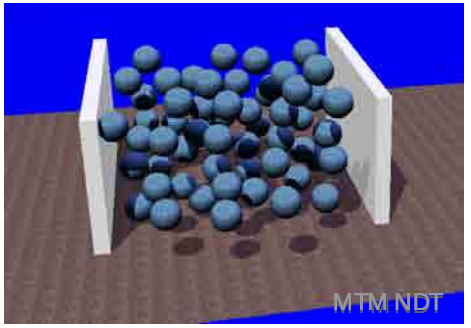
Detection of corrosive liquids

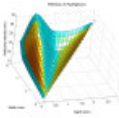
Conductor versus isolator

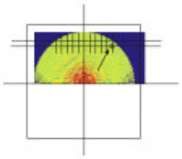
Percolation conductivity

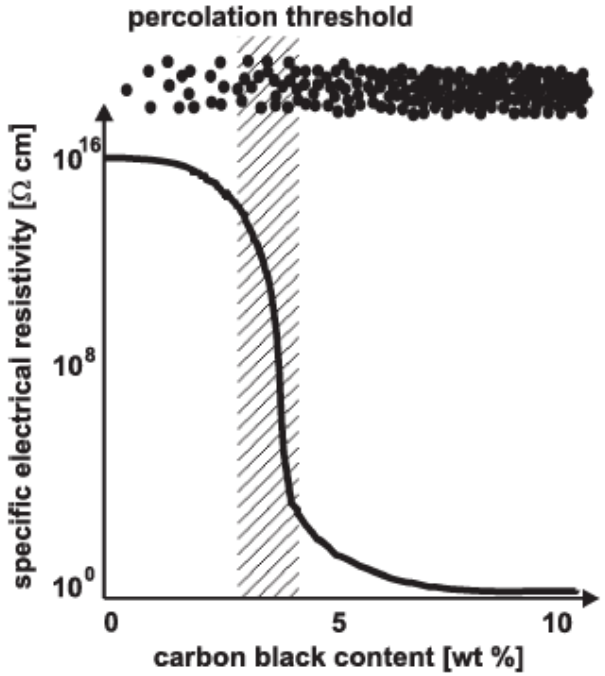


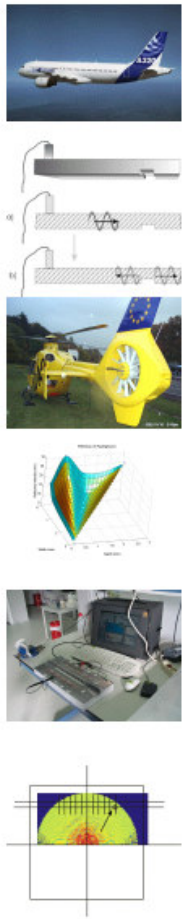








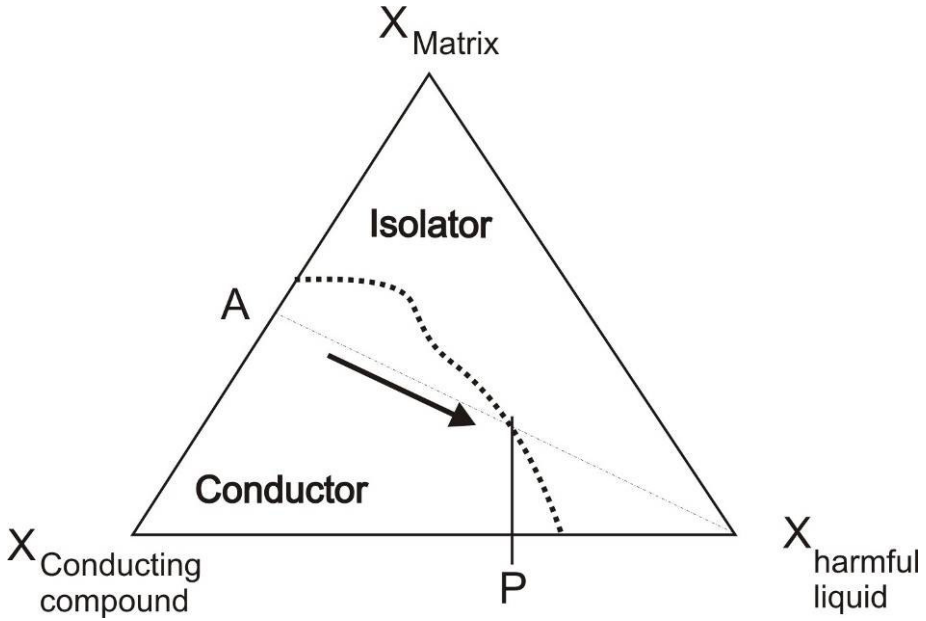


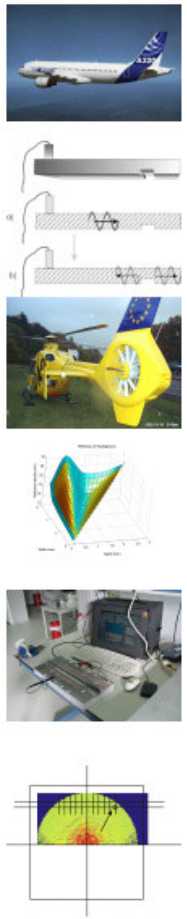


Electrically conductive glass fibre reinforced epoxy resin

Mat Res Innovat (1998) 2:164–169

PCS – Percolation conductivity sensor





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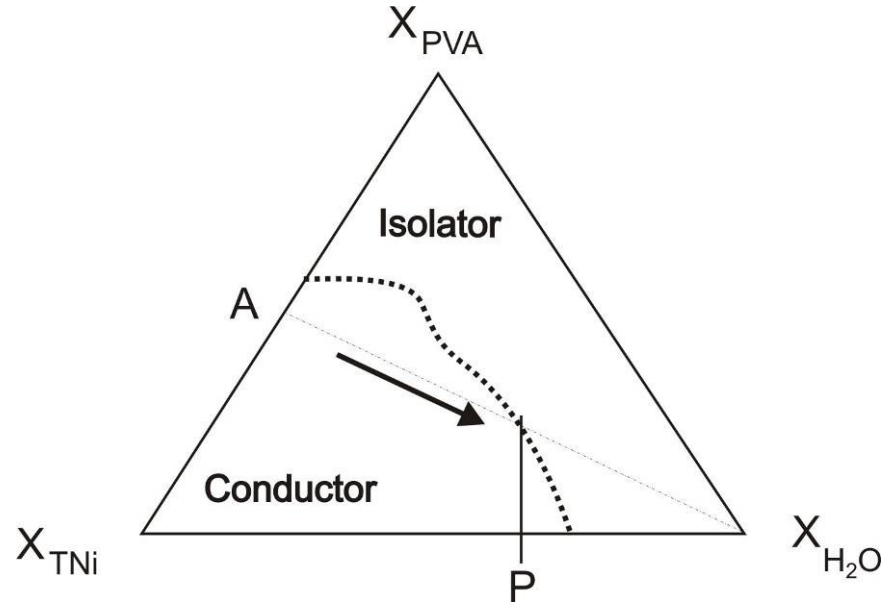

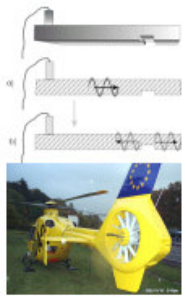

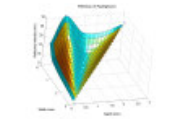

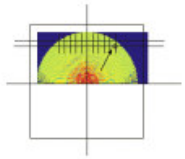

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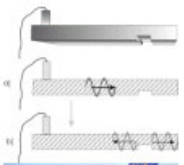
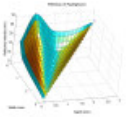
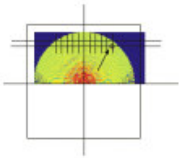
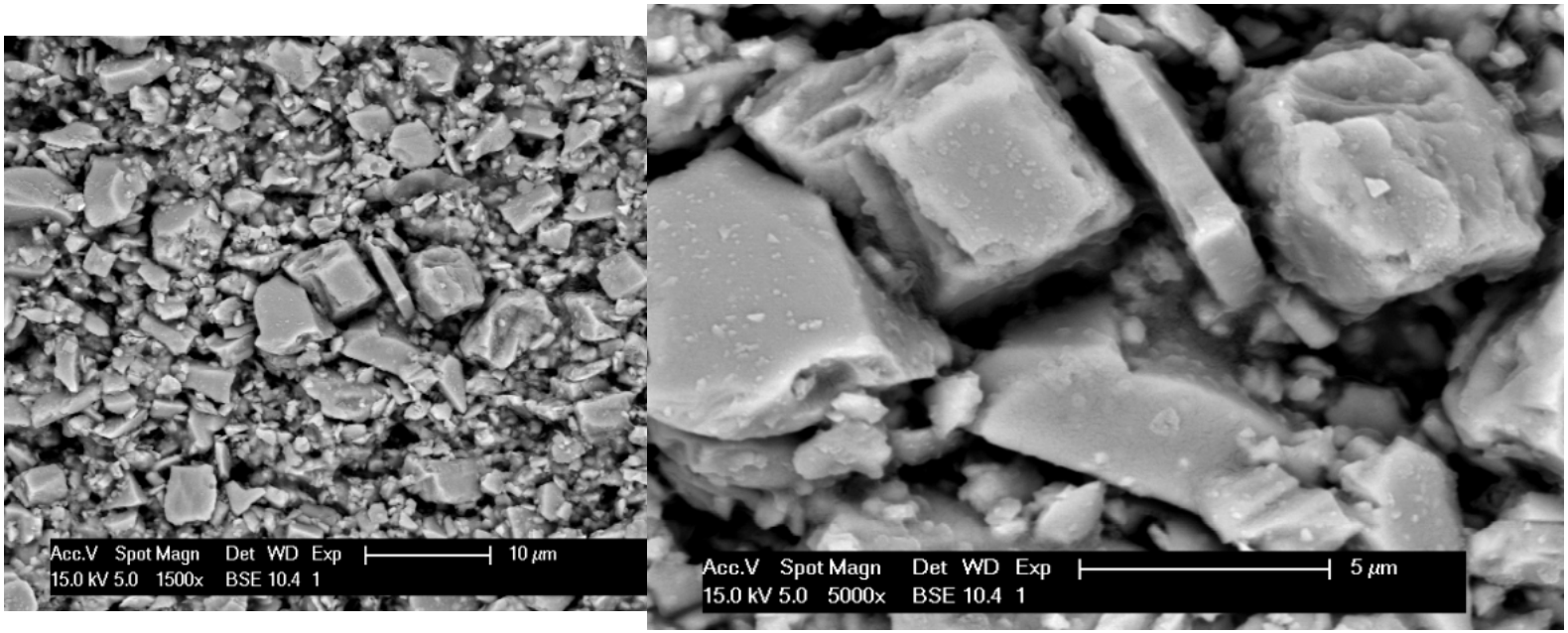


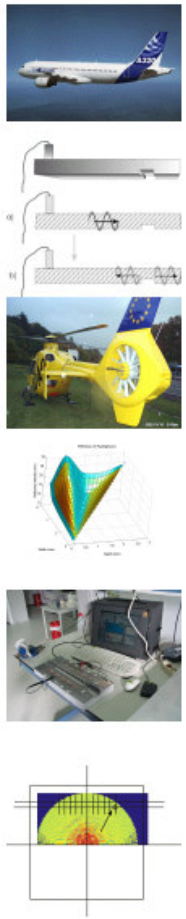




- **Detect aqueous liquids**
  -> Use hygroscopic matrix, e.g. PVA
- **Use an inert, unharmful conductive compound**
  -> conductive ceramic powder
- **Design appropriate mixture**
  -> close to percolation threshold

PCS – Percolation conductivity sensor





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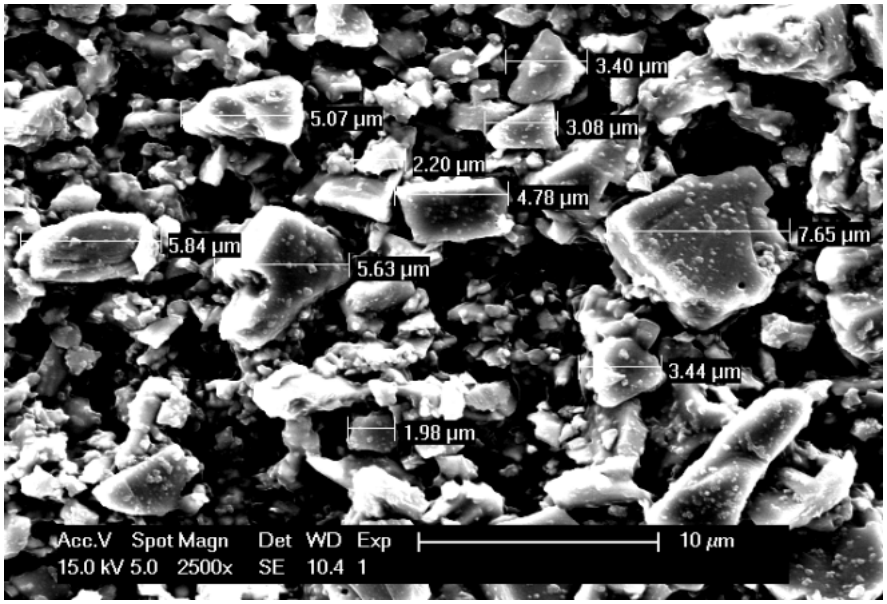
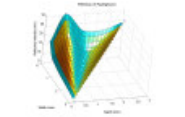
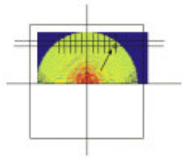
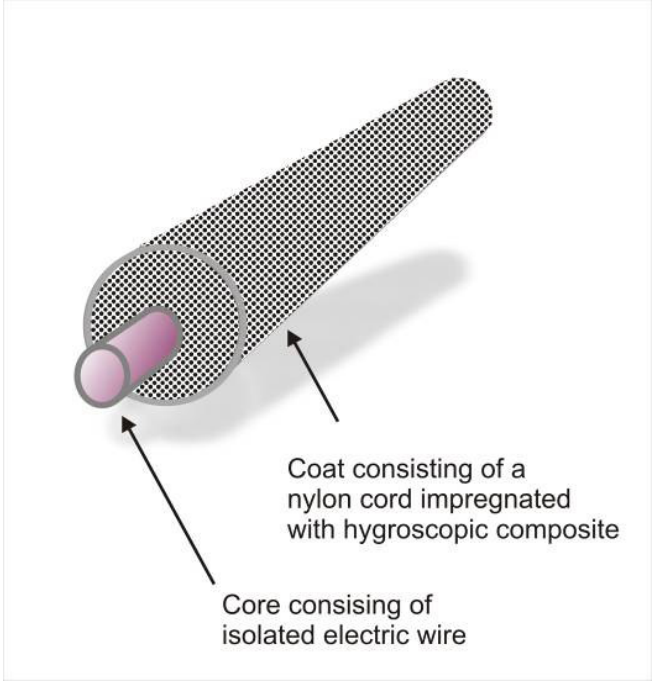
PCS – Percolation conductivity sensor

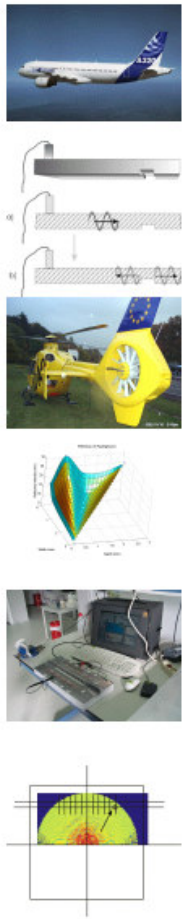






PCS – Percolation conductivity sensor





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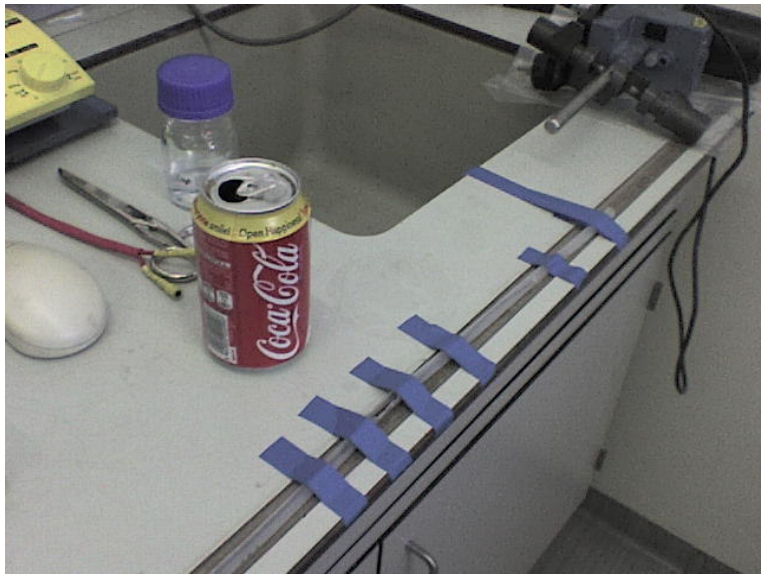

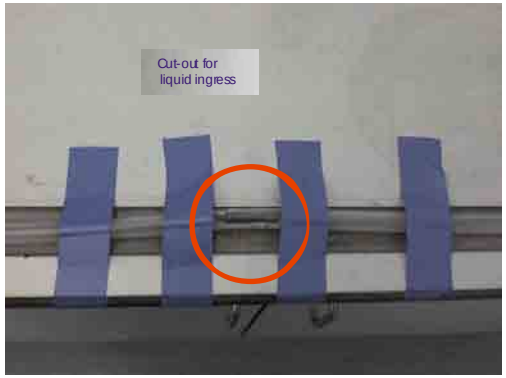

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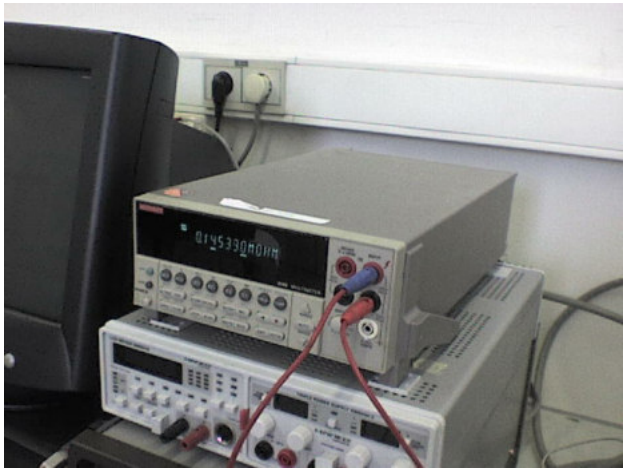

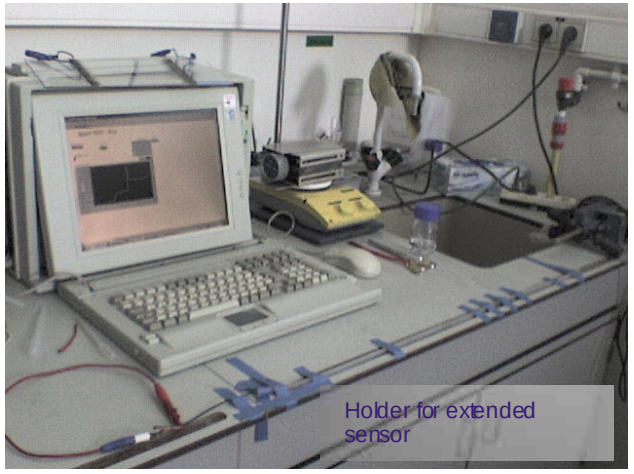

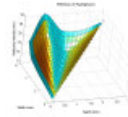

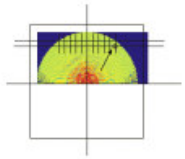

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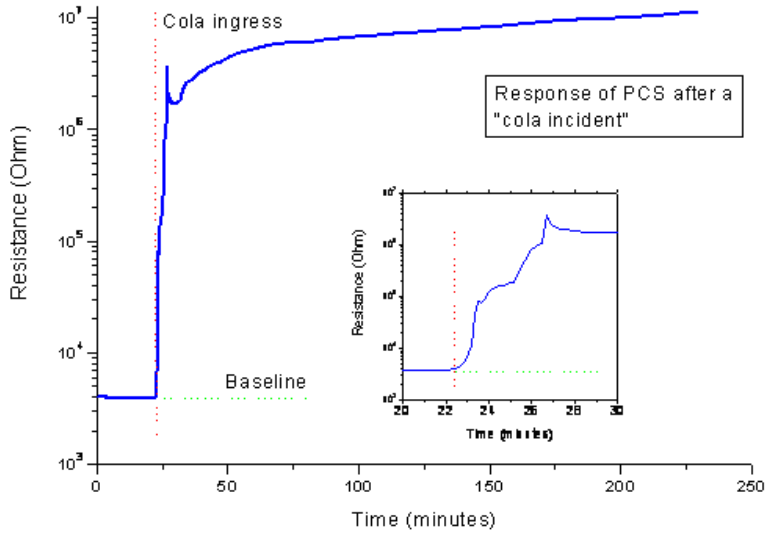
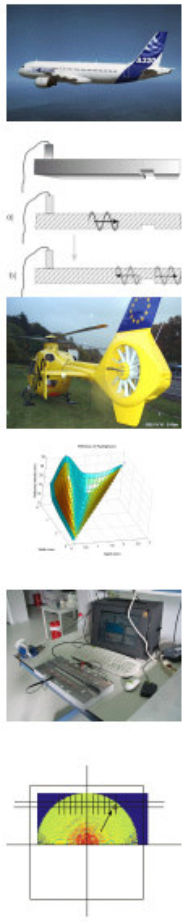
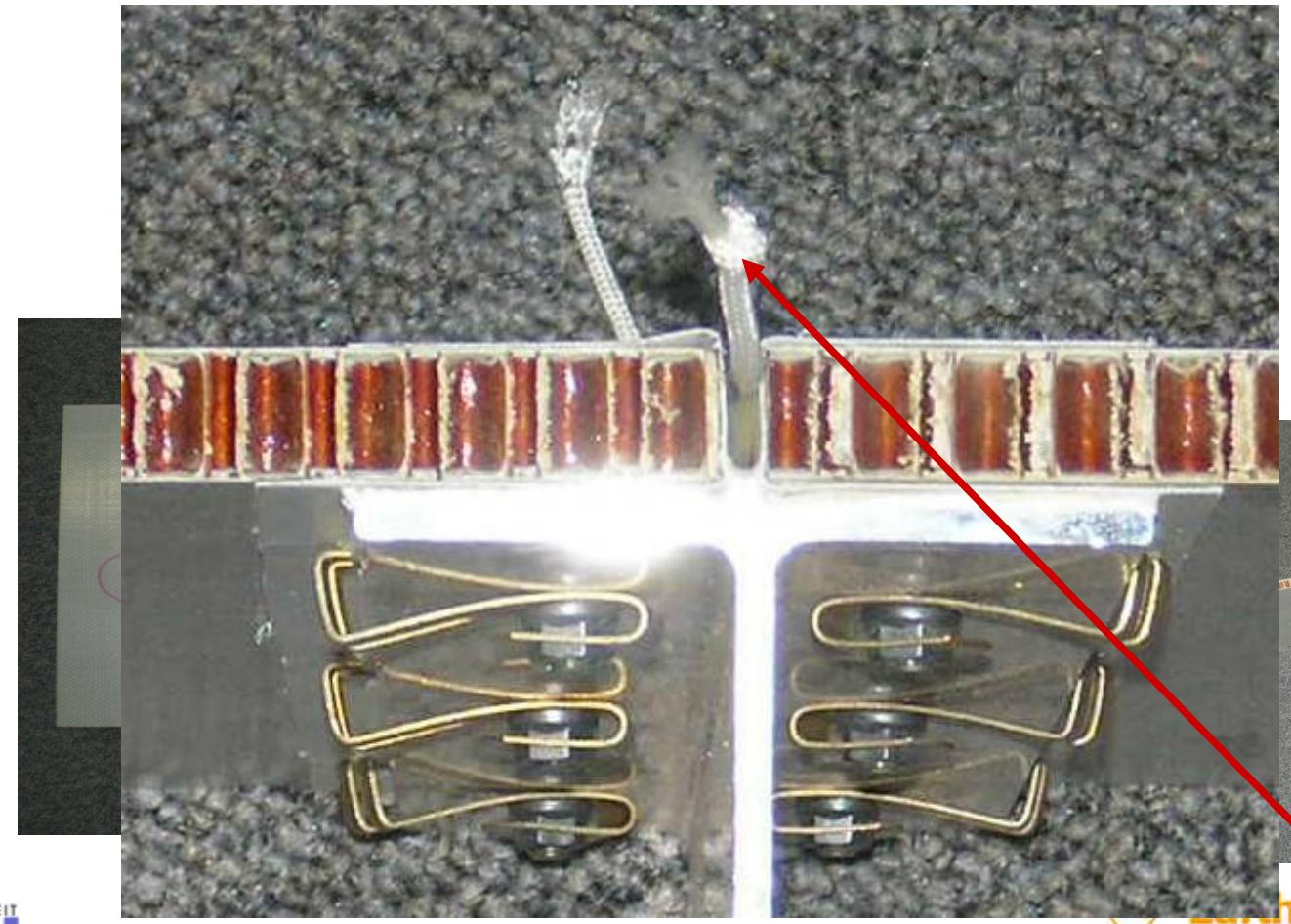
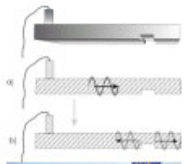
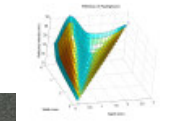
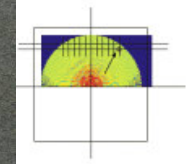


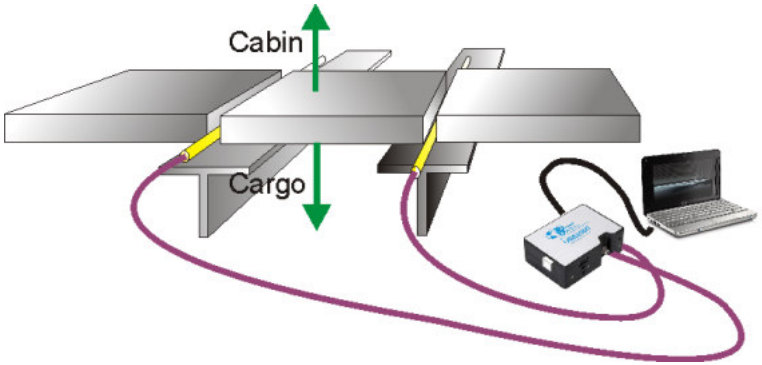




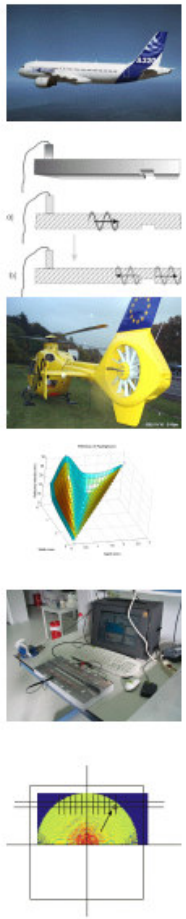


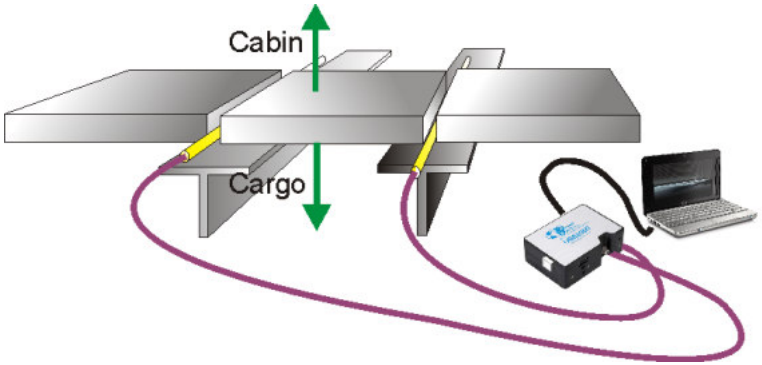




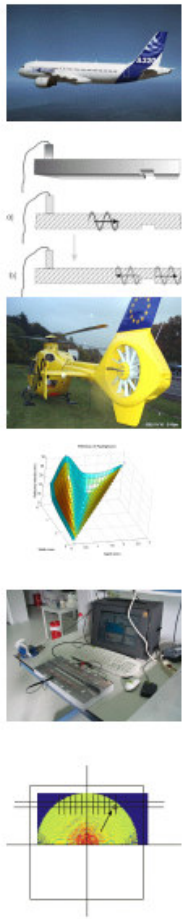


- Extended sensor
- A limited number of sensors cover liquid-exposed positions at the cabin area
- Sensor has buffer capabilities – small amounts of liquids are absorbed
- No heavy certification issues to be expected

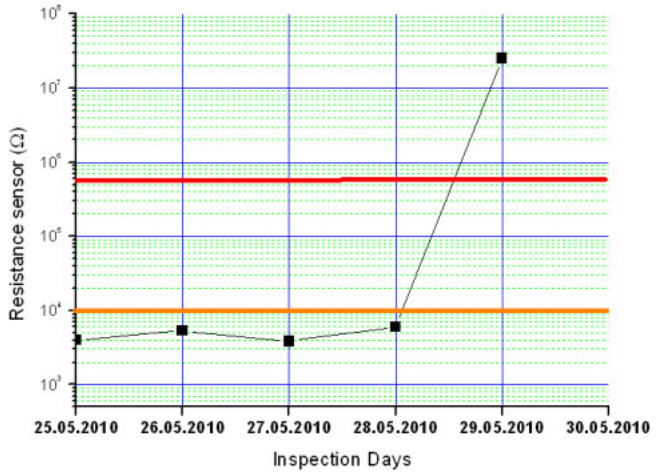




- Ingredients almost free of charge
- Reading out possible by a simple multimeter during light maintenance
- Ingredients unharmful

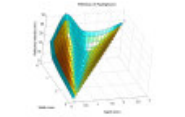


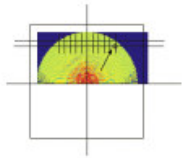
PCS – Percolation conductivity sensor



Next steps

- For AISHAI II Implementation in airplane before end of 2010 (galley, lavatory, service door area)
- Data are collected during light maintenance and analysed by LHT/MTM
- “success” difficult to measure when no liquid ingress happens





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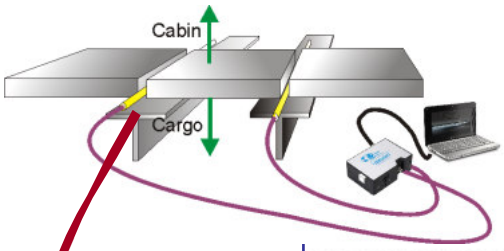
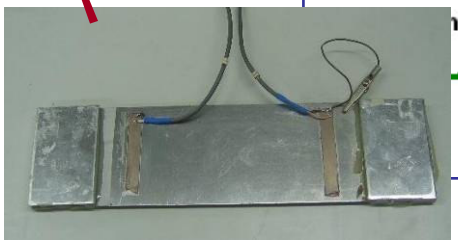
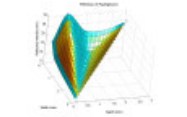


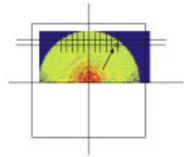
TECHNOLOGY ASSESSMENTS

TECHNOLOGY READINESS LEVELS

System Test, Launch & Operations	TRL 9	Actual system "flight proven" through successful mission operations
System/Subsystem Development	TRL 8	Actual system completed and "flight qualified" through test and demonstration (Ground or Flight)
	TRL 7	System prototype demonstration in a space environment
Technology Demonstration	TRL 6	System/subsystem model or prototype demonstration in a relevant environment (Ground or Space)
Technology Development	TRL 5	Component and/or breadboard validation in relevant environment
	TRL 4	Component and/or breadboard validation in laboratory environment
Research to Prove Feasibility	TRL 3	Analytical and experimental critical function and/or characteristic proof-of-concept
...nology	TRL 2	Technology concept and/or application formulated
	TRL 1	Basic principles observed and reported







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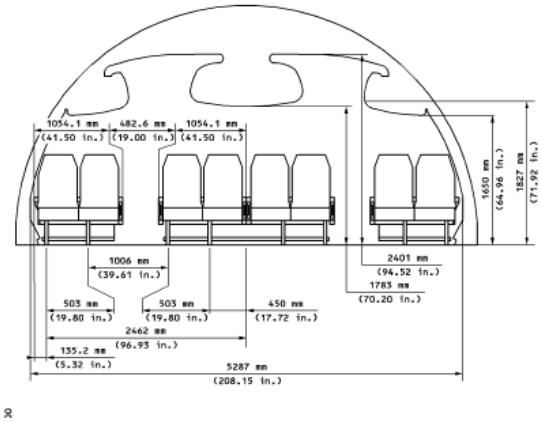
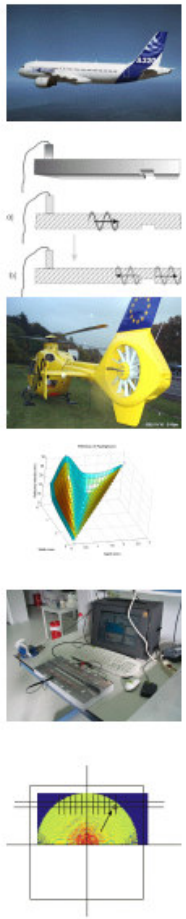
First implementation area





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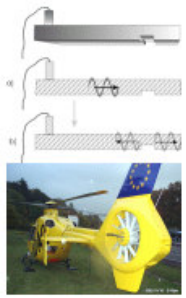
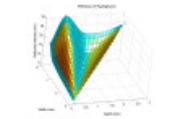
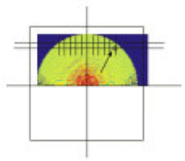
PCS – Percolation conductivity sensor







End of 2010, ready to take off …. for the AISHA II sensors?

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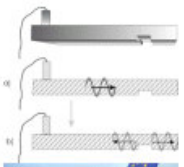
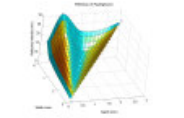
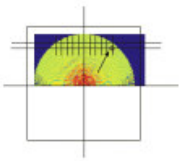
PCS – Percolation conductivity sensor

-> Extension to different liquids



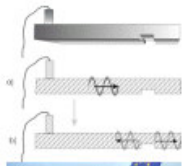


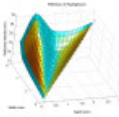


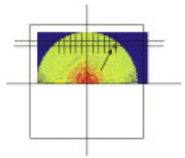
Pinhole cracks in hydraulic tubes – SKYDROL detection

When the cracks go through the complete tube:

- Initially, a fine hair crack exists, and the hydraulic fluid leaves the tube like in an aerosol spray – the aerosol condenses and/or it is spread by e.g. the airconditioning
- Later, plenty amounts of hydraulic liquid leave the crack







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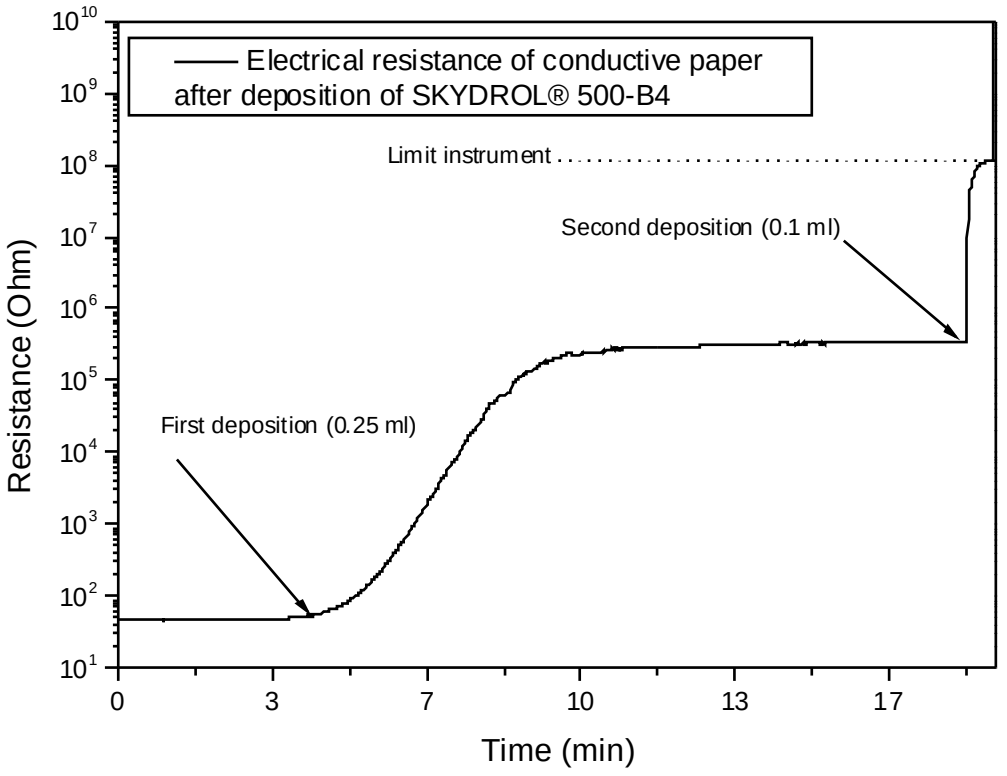

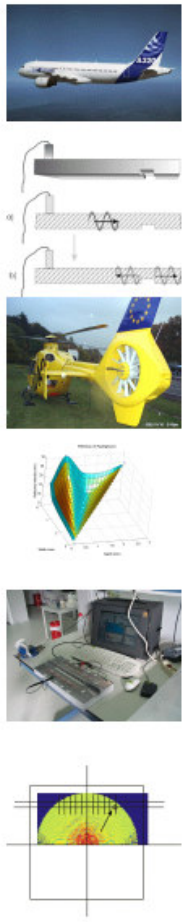

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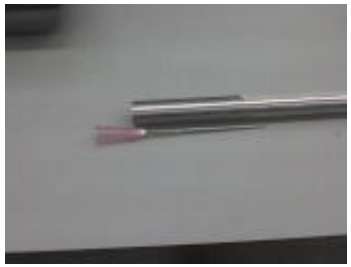

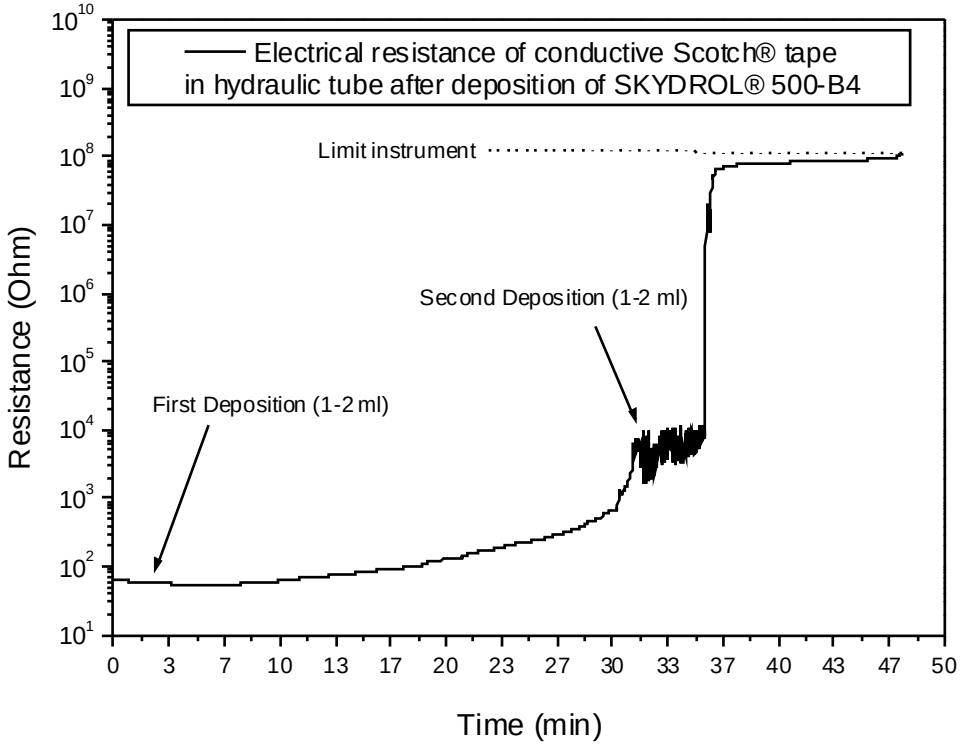

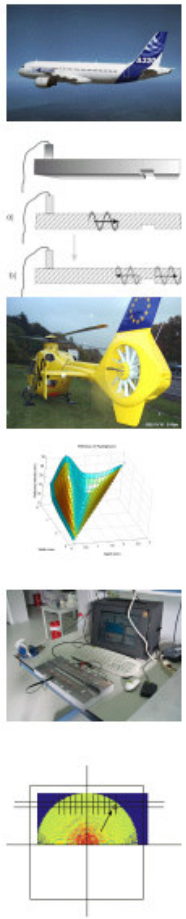

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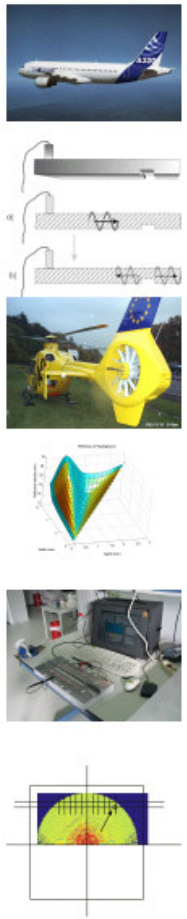
Conclusion

° Percolation threshold sensors developped for
  - aqueous liquids (galley area, lavatory, service door, …)
  - phosphate ester based hydraulic liquids (SKYDROL etc)
° Extreme cheap materials
° Mainly rely on certified components
° Low certification threshold expected
° “Fuse” functionality (sensor keeps its state)
° Signal many orders of magnitude above baseline variations
° Reading out by a simple multimeter

Is this structural health monitoring??? … you protect your structure by detecting harmful liquids passing through damaged sealings, pipes, …



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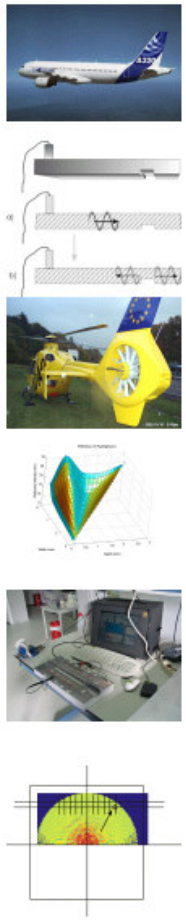
EU- FP7 - CP 212912

Acknowledgements

The research leading to these results has received funding from the European Community's Seventh Framework Programme [FP7/2007-2013] under grant agreement n°212912 (Project: Aircraft Integrated Structural Health Assessment II - AISHA II).
We want to thank Gregory Pyka for performing the SEM analysis and Johan Vanhulst for establishing the data logging facilities. Furthermore, a special thank to Kim Vanmeensel and Wout Veulemans for the support with the ceramic powder technology.



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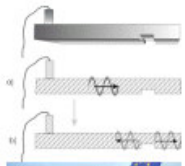
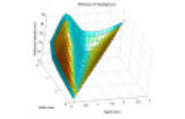
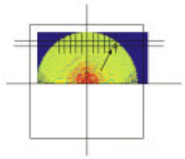
Thank you for your attention







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