Project Proposal
GA - SMART

former

Active / Passive Acoustic SHM System for Impact Detection **(APASHI)**
Adaptive Impact Absorption and SHM for General Aviation **(AIA-GA)**

"General Aviation and European Air Transport System Third Call FP7“, Workshop no 2
BRUSSELS, Polish Science Contact Agency (Pol. SCA), Rue du Throne 98, 1050 Brussels, 23 November 2009

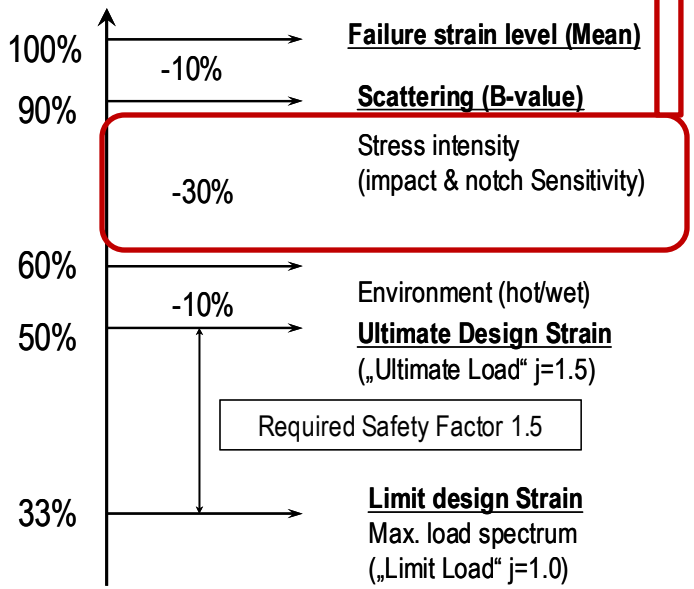
Dr. Michael Scheerer/ AMAT- Aerospace & Advanced Composites

Project Idea

- **Development and Application of a Active / Passive Acoustic Structural Health Monitoring System for (Impact) Damage Detection in primary composite structures using cheaper and easy to install or even embeddable sensors**

Motivation for SHM in Composite Structures

- Certification Issues



Hachenber D. 2002, “The role of Advanced Numerical Methods in the Design and Certification of Future Composite Aircraft Structures“ 5th world congress on Computational Mechanics WCCM V, Vienna, Austria, July 7-12, 2002

Potential for SHM by impact & delamination detection

- **Individual Maintenance / Repair Strategies –**
- **From Time Based Maintenance to Condition Based Maintenance**
- **Control of difficult / impossible to inspect parts**
- **Optimized Design**

  To date:

  uncertainties in integrity of their manufacture

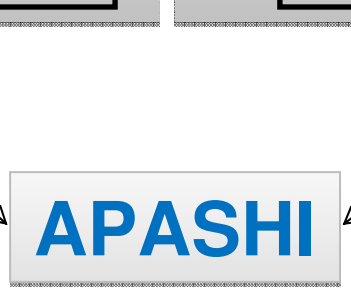
  susceptibility to barely visible impact damage (BVID)

Design load: 33% of failure load compared to 60% in metals

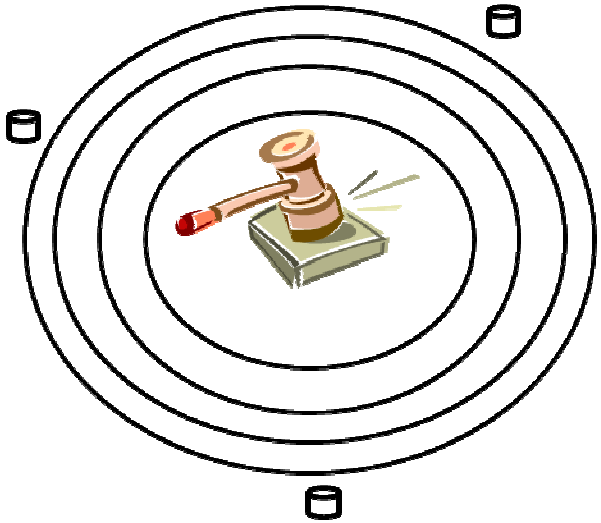
Lessons learned from CESAR Project
Active vs. Passive Acoustic SHM Systems

- **Active Systems**
  - Drawbacks
    - Strong influence of environment (temperature)
    - Defect location accuracy: moderate
  - Advantages
    - Off- and Online Usage
    - No loads required

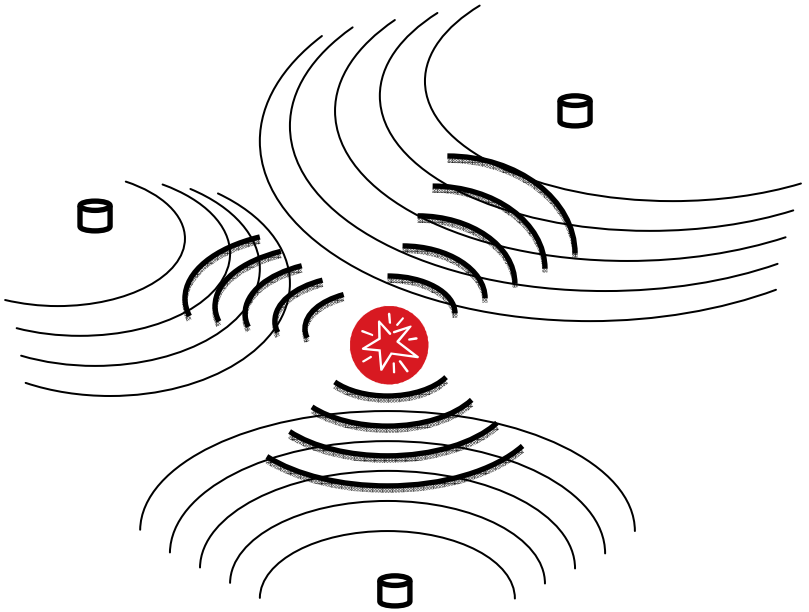
- **Passive Systems**
  - Drawbacks
    - Loading is required
    - Results depend strongly on loading conditions
  - Advantages
    - excellent location accuracy
    - Limited influence of environment (temperature)



Active / Passive Acoustic SHM System Concept



Passive Part:
Impact Location and Strength



Active Part:
Damage Severity

Proposed Project Steps

- **Identification of relevant types and sizes of damages for a prototype primary composite structure**
- **Analyses of the necessary actuator / sensor configuration**
- **Definition of the hardware / software requirements**
- **Development / Procurement of the necessary hardware**
- **Development of the damage quantification algorithm**
- **Verification of the system on simplified substructures and the final prototype structure under simulated real environmental conditions**

Current Partners

Participant no.	*Participant organization name / short*	*Country*	*Contact Person*
1	Institute of Aviation **IoA**	Poland	
2*	Austrian Institute of technology **AIT**	Austria	Ernst Semerad Michael Scheerer
3	National Aerospace Laboratory **NLR**	Netherlands	Ronald Beukema
4	Materials Engineering Research Laboratory **MERL**	United Kingdom	Stefanos GIANNIS
5	**VZLU**	Cech Republik	Jiri Behal
6	Italian Aerospace Research Centre **CIRA**	Italy	Antonio M. Calabrò
7	**AERNNOVA**	Spain	Valerijan COKONAJ
8	**PARAGON LTD**	Greece	Harry Tsahalis
9	Institute of Fundamental Technological Research **IPPT**	Poland	Jan Holnicki-Szulc
10			

Project structure

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WP No	Name of WP	Activity Type	Participant Short Name
WP1	**Assesment of existing active and passive SHM methods for damage detection in composites**		**AIT, NLR, CIRA**
T1.1	Survey of existing active SHM methods		
T1.2	Survey of existing passive SHM methods		
T1.3	Definition of Requirments to merge active and passive methods		
T1.4	Status of current detection capability in composites		
WP2	**Development of Active / Passive Hardware Components**		**VZLU, Aernnova**
T2.1	Development of Actuation Hardware and actuators		
T2.2	Development of Detection Hardware and Sensors		
T2.3	Develpoment of combinded Active / Passive hardware platform		
WP3	**Development of Active / Passive Algorithms**		**AIT, AERNNOVA, PARAGON, IPPT**
T3.1	Development of Algorithms for Active Damage Detection		
T3.2	Development of Algorithms for Passive Damage Detection		
T3.3	Development of combined active / passive Algorithms		
WP4	**Verification Testing on Subcomponents**		**VZLU, MERL**
T4.1	Defintion of Subcomopnents		
T4.2	Defintion of Damages and Loading conditions		
T4.3	Verification Testing		
WP5	**Structural Component Test in simulated environment**		**VZLU, MERL**
T5.1	Defintion of Comopnents		
T5.2	Defintion of Damages and Loading conditions		
T5.3	Component Testing in simulated Environment		
WP6	**Evaluation of Tests - Assessment for Condition Based Maintainance**		**All**
T6.1	Test evaluation		
T6.2	Development of Methods for CBM		