European Aeronautics Science Network

The European Aeronautics Science Network Association

Endorsed projects for the 6th FP7 call

Presented by: Michael Papadopoulos

European Aeronautics Science Network

Projects overview

CORSAIR	Cold Spray Radical Solutions for Aeronautic Improved Repairs
Ti-TECH	Additive Manufacturing Techniques for Aerospace Titanium Components
MULMON	Multilevel Data Integration in Structural Health Monitoring
MOVER2	Multilevel/Multidisciplinary Optimisation for Design of Aeronautical Structures
AISHA+	Aircraft Integrated Structural Health Assessment +
VIVID	Virtual Assessment of Low-velocity Impact Damage in Composite Airframes
DREAMCOMP	A Universal Approach in Developing Robust and Energy Efficient Monitoring, Optimasation and Control Technologies for Ecolonomic Composites Processing
EFRA	Environmental Friendly Aircraft

European Aeronautics Science Network

CORSAIR: Coldspray Radical Solutions for Aeronautic Improved Repairs

Coordinated by: *Dr. Simone Vezzù (Veneto Nanotech scpa, ITALY)*

Core Partnership:

- ***Research Organizations (5):*** *Veneto Nanotech scpa (ITALY), Politecnico di Milano (ITALY), University of Juan Rey Carlos III (SPAIN), TWI (UK), National Aerospace University (UKRAINE)*
- ***Industrial Partners (7):*** *AVIO (ITALY), EADS Deutschland (GERMANY), ALESTIS AEROSPACE (SPAIN), IMPACT INNOVATION (GERMANY), LPW (UK), METALOGIC (BELGIUM), EASN (BELGIUM)*

Challenge: Competitiveness Through Innovation

Activity in Work Programme: 7.1.1 The Greening of Air transport

Area in Work Programme: *AAT.2012.1.2-2. Maintenance and Disposal*

- **Project content and goals:**
  - Use of Cold Spray Technology as low temperature and high efficiency repair technology for aeronautic components and structures.
  - Focus in components and frames in light alloys: Al, Mg and Ti alloys.
  - Design and Development of a portable unit in order to provide quick and high-performances *in-situ* repairs.

- **Expected impact:**
  - **Improving the cost-efficiency** and **time-efficiency** by the implementation of a high-performance and high-efficiency repair technology: (1) increase the capability to **re-use of components** by repair. (2) increase the **life-time of components** by high-performances protective repairs. (3) possibility to define and realize **cost-effective *in-situ*** repairs.
  - Improving the **greening of air transport** by increasing both the full recyclability and full lifetime of components and by substituting actually processes by using a ecofriendly repair technology (Cold Spray)

Partners needed to complete the consortium

- **ONE** industrial partners involved in production of aeronautic components and/or structures (some agreements were actually in discussion even if for instance no official agreements have been received by other industrial partners).

European Aeronautics Science Network

Ti-TECH: Advanced Additive Manufacturing Techniques for Aerospace Titanium Components

Coordinated by: *University of Patras, Lab for Manufacturing Systems & Automation (LMS)*
Director
Prof. George Chryssolouris
E-mail: xrisol@lms.mech.upatras.gr

Core Partnership:

University of Patras (LMS+LTSM), EADS-D, ALENIA

Challenge: Competitiveness Through Innovation

Activity in Work Programme: 7.1.4 Improving Cost Efficiency

Area in Work Programme: AAT.2013.4-4 Maintenance, Repair and Disposal

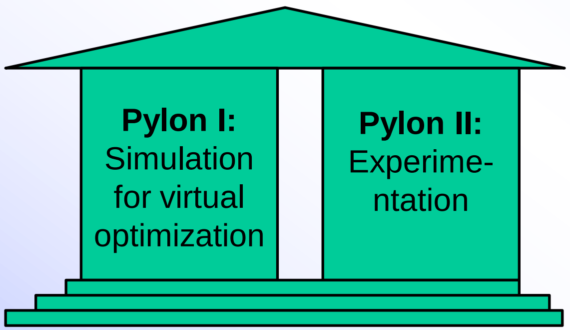
European Aeronautics Science Network

- ***Project content and goals:***

Develop – improve additive manufacturing technologies for delivering medium size metallic components from Ti-6Al-4V that meets the needs of aerospace sector.

Main Technical Goals: increase building speed, reduce cost and minimize residual stresses of the final part, in an energy efficient way.

Approach:



RTD activities:

- Virtual prototyping
- Process Simulation
- Virtual manufacturing
- Manufacturing and testing
- Quality evaluation

- ***Expected impact:***

Development of novel low cost laser based additive manufacturing technology for producing ready for use metallic parts for servicing on site aircraft components.

- Introduce JIT components for the maintenance of aircraft components
- Standardize AM technologies for different aerospace applications such as: Rib-Web structural components, turbine engine cases, blades, etc

Expected Advantages and Benefits

– Reduced Raw Material Usage
– Reduced Raw Material Stock Size
– Reduced Machining Operations
– Reduced Hard Tooling Requirements
– Reduced Procurement Lead Time
– Reduced Acquisition Cost
– Salvaging of Damaged High-value Components

Partnership / Consortium Structure

- **Potential University partners**
  - University of Patras (LMS + LTSM)
  - …
- **Potential SME or Research Establishments partners**
  - SLS machine developer
- **Potential industrial partners**
  - EADS-D
  - ALENIA
  - ...

European Aeronautics Science Network

MULMON: Multilevel Data Integration in Structural Health Monitoring

Coordinated by: *University of Salerno*
Director
Prof. Flavio Giannetti
E-mail: fgiannetti@unisa.it

Challenge: Competitiveness Through Innovation

Activity in Work Programme: 7.1.4 Improving Cost Efficiency

Area in Work Programme: AAT.2013.4-3 Production

European Aeronautics Science Network

Main goal:

To produce a working demonstrator of the multilevel process that will produce a synthetic information on structural health status.

Expected impact:

In an aircraft component, the expert designer can locate some areas mainly subject to different kind or level of damage due to different causes. This information can be useful to organize the sensor positioning into a multilevel logic. Further, the damage classification allows to give a multilevel organization to the sensors interrogation and data fusion. The sensor system should scan the whole component volume in order to seek in sequence for the different damage categories.

In every component area previously defined by the designer, the position of the sensors array is optimized with the objective to maximize the sensitivity / reliability of the system to correctly locate the first level of damage, using the minimum sensor number. Further damage levels can be correctly located and classified using the proper level of sensor interpretation or data fusion technique, in the framework of the multilevel methodology.

European Aeronautics Science Network

Mover2: Multilevel/Multidisciplinary Optimisation for Design of Aeronautical Structures

Core Partnership (provisional):

Imperial College, DLR, Delft, ALENIA

Challenge: Competitiveness Through Innovation

Activity in Work Programme: 7.1.4 Improving Cost Efficiency

Area in Work Programme: AAT.2012.4.1-1 Design Systems and Tools, AAT.2012.4.1-2 Aerostructures

The proposed platform in Mover2 is a multilevel based optimisation, reproducing the flow of information among the different technical departments of an aeronautical industry for the sizing of the structural component. The challenges of this research project is to develop and apply an integrated multilevel and multiscale design platform to an outer wing-box. To do this, four levels of analysis will be considered : Preliminary Design, corresponding to the trade constraints; Architecture and Configuration Identification (joints, rough material selection, major damage sizing); Detailed Analysis (materials, frame and string shape, rivet, bonding) and material model description which is a deeper fourth level.

European Aeronautics Science Network

AIRCRAFT INTEGRATED STRUCTURAL HEALTH ASSESSMENT +

Coordinated by: KU Leuven (University of Leuven) - Belgium

AISHA +
SHM + aNDT

- **Activity in Work Programme**
  - 7.1.4. IMPROVING COST EFFICIENCY
- **Area in Work Programme**
  - 7.1.4.2 Aircraft operational cost
- **Topic in Work Programme**
  - AAT.2013.4-5 MAINTENANCE, repair and disposal

- **Activity in Work Programme**
  - 7.1.1 THE GREENING OF AIR TRANSPORT
- **Area in Work Programme**
  - 7.1.1.1 Green aircraft + 7.1.1.2. Ecological production and maintenance
- **Topic in Work Programme**
  - AAT.2013.1.1-2 AEROSTRUCTURES

European Aeronautics Science Network

AIRCRAFT INTEGRATED STRUCTURAL HEALTH ASSESSMENT +

AISHA +
SHM + aNDT

PROJECT

Finally, structural health monitoring (SHM) can replace traditional non-destructive testing. Meanwhile, **indicative low-end SHM** combined with advanced non-destructive testing (**aNDT**) is the optimum choice.

→ Implementation of SHM in relevant full-scale aircraft structures (metals and composites undergoing fatigue, impact, corrosion damage) provided by **maintenance companies/departments**.

→ Use of **percolation** sensors (leakage detection), **ultrasonic** guided waves (non-linear ultrasonics, time-of-flight, full-field imaging), **optical** methods (polarisation enhanced visual inspection) and corrosion monitoring with **electrochemical** methods.

→ Finally, the target are robust sensor networks while **avoiding complex on-board systems**.

AIRCRAFT INTEGRATED STRUCTURAL HEALTH ASSESSMENT +

AISHA +
SHM + aNDT

PARTNERS

… needed with practice in **aircraft operations** (such as airlines, maintenance, repair and overhaul companies (MRO) to provide **access** to relevant full-scale parts for the implementation of SHM systems within in the scope of the project

IMPACT

Use the experience from the **FP7 AISHA II** project (e.g. a floorbeam sensor was certified and successfully implemented in three **operational airliners**) and give it a new dimension by focusing on further implementation at the highest technological readiness level (TLR) possible. SHM sensors should be designed and performed as **minor modifications** whenever possible to reduce the time to market.

European Aeronautics Science Network

VIVID: Virtual Assessment of Low-velocity Impact Damage in Composite Airframes

Coordinated by: *Prof. Alessandro Pirondi, University of Parma (IT),*

Core Partnership:

Politecnico di Milano, LMT Cachan, Lublin University of Technology, University of Patras, Bercella srl, EASN, SAMTECH, SONACA

Challenge: Eco-Innovation, Competitiveness Through Innovation

Activity in Work Programme: 7.1.1 The Greening of Air Transport, 7.1.4 Improving Cost Efficiency

Topic in Work Programme: *AAT.2013.1-2. Aerostructures, AAT.2013.4.-2. Design systems and tools*

European Aeronautics Science Network

- **Project content and goals:** the project is aimed at developing and validating experimentally advanced modeling tools for the **virtual assessment** of the airframe with respect to **low-velocity impact damage tolerance.** Typical example: impact from tools falling during maintenance.
- 1. In order to provide a good usage of these advanced capabilities, correct values for model parameters should be used. This can be done thanks to a large numerical tests campaign, to be compared to a corresponding experimental test campaign for validation.
- 2. A distinctive point of VIVID is to implement new models into an existent commercial finite element software developed by a project partner . This allows to make the developments durable in a European software and to solve problems with a complexity level that cannot be reached with the academic in-house finite element codes.
- 3. Fatigue crack and damage growth capabilities will also be developed. Fatigue prediction in composites is clearly becoming a hot topic for the aerospace industry.
- 4. Efficient optimization methods available by project partners could be used to design composite structures in order to minimize the occurrence of damage, or to optimize composite structures from an experimental data base of damage scenarios that will be developed in VIVID.

European Aeronautics Science Network

Expected impact:
Aircraft Safety, Development and Operation Cost, Environment

- to reduce uncertainties regarding the safety-critical decision of inspecting the airframe;
- to be able to precisely predict the scenario of damage tolerance of the design adopted and improve it exploring virtually several different materials and design solutions reducing the need of demanding experimental campaigns.
- to define more precisely inspection intervals, maintenance procedure, life extension or disposal at the design stage and during service improving both scheduled and unscheduled maintenance, avoiding unnecessary inspections and extending allowable damage limits, which means in turn a less grounded aircraft.
- to reduce direct operation costs (reduction of fuel consumption due to lower weight, which impacts the Greening of Air Transport).
- to reduce purchase costs due to **lower development cost** because of the physically-based nature of damage models that allows a less demanding experimental plan to transfer damage tolerance information from coupon to structure.

Cross-fertilization in other industrial sectors

- aircraft engines, automotive, train, shipbuilding, mechatronics.

Partners needed to complete the consortium

- the Consortium is looking for one-two further industrial partners, including SMEs

European Aeronautics Science Network

DREAMCOMP: A Universal Approach in Developing Robust and Energy Efficient Monitoring Optimisation and Control Technologies for Ecolonomic Composites processing

Coordinated by: *Advances and Innovation in Science and Engineering -ADVISE i*

Core Partnership: *University of Reading, University of Patras, GMI, Hukseflux, TWI Ltd., Exel Composites UK, ATARD*

Challenge: Competitiveness Through Innovation

Activity in Work Programme: 7.1.4 Improving Cost Efficiency

Area in Work Programme: AAT.2013.4-3 Production

European Aeronautics Science Network

This project proposes the development of a turn-key, flexible and robust manufacturing tool aiming to adapt existing technologies on monitoring, optimisation and control systems

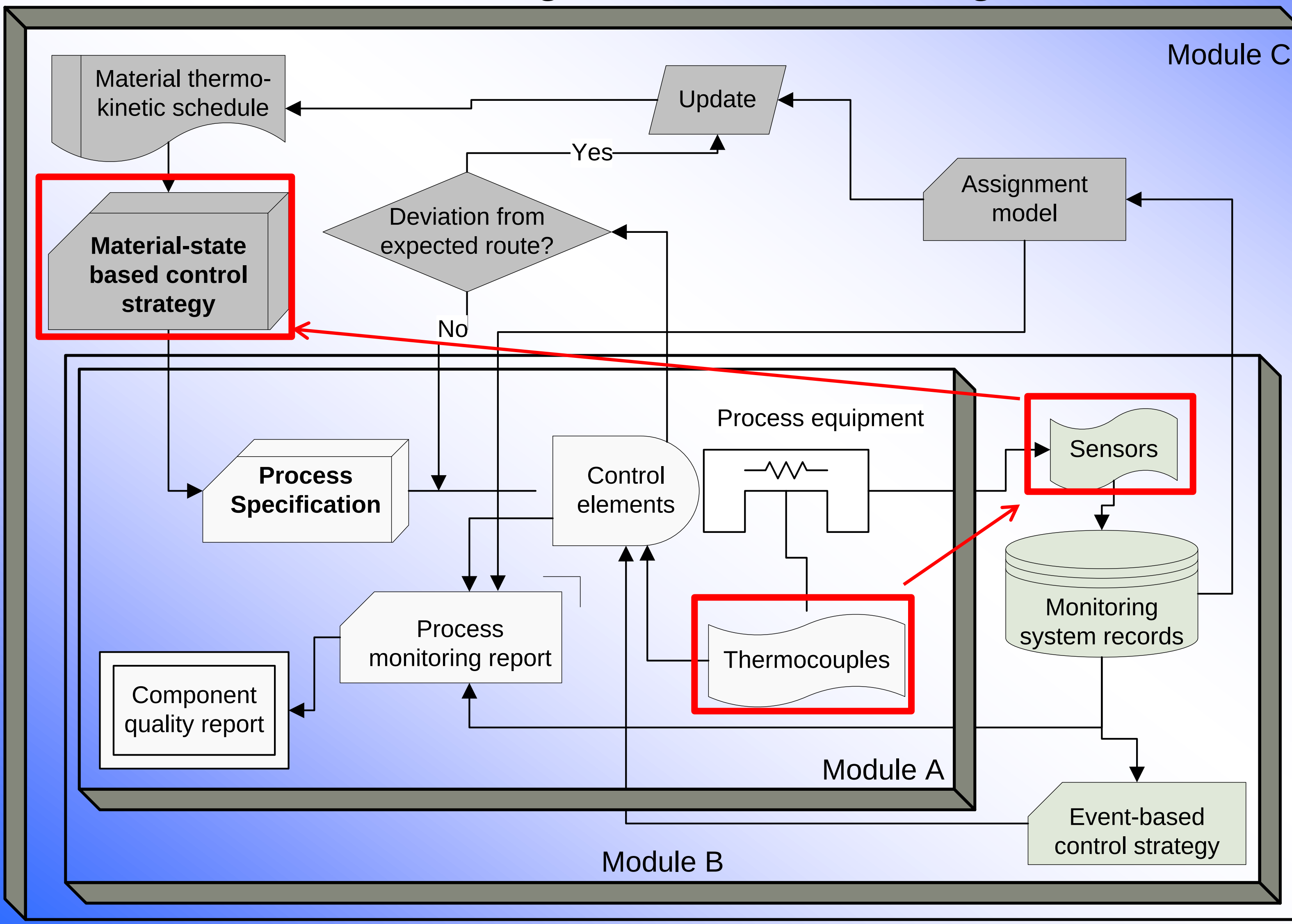
through the refinement of

- material-state modelling and sensing signal interpretation modules applicable to a wide range of matrix systems (thermoset- and thermoplastic-based),
- developing robust optimisation and control algorithms based on an ecolonomic decision making strategy applicable to a wide range of process equipment and manufacturing methods.

European Aeronautics Science Network

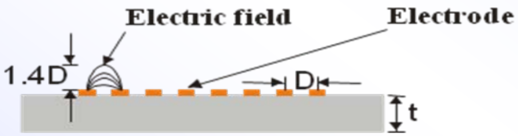
Composites process control

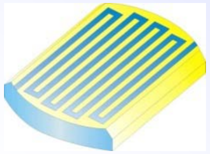
Three levels of control with increasing level of material knowledge



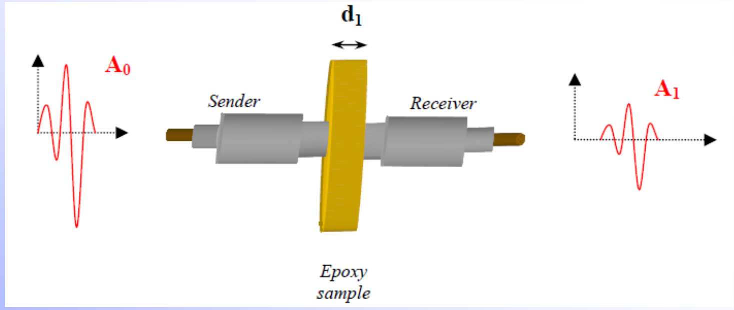
European Aeronautics Science Network

Development of in-process sensing techniques





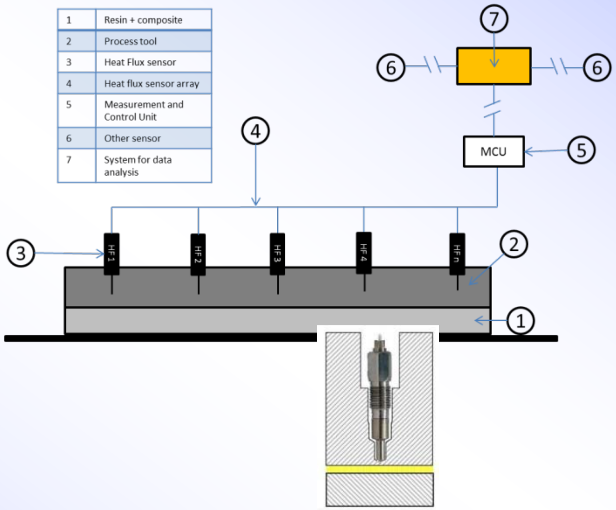
dielectric sensors



ultrasound sensors

Indicative Past Work - Technology developed within EU projects:

- CONDICOMP (FP5 GROWTH)
- COMPROME (FP6 Aero STREP)
- SENARIO (FP6 Aero STREP)



1	Resin + composite
2	Process tool
3	Heat Flux sensor
4	Heat flux sensor array
5	Measurement and Control Unit
6	Other sensor
7	System for data analysis

heat flux sensors

temperature monitoring *only* is not sufficient!!!

- part geometry & environment strongly effects heat flow!
- material properties can be derived from sensor signals

EFRA: Environmentally FRiendly Aircraft

Coordinated by: *Delft University of Technology*
R.N.H.W van Gent, R.N.H.W.vanGent@tudelft.nl

Core Partnership:
EADS-Innovation Works, BauHaus Luftfahrt, Piaggio Aero, University of Cambridge, University of Stuttgart, European Aeronautics Science Network, Delft University of Technology

Challenge: Competitiveness Through Innovation

Activity in Work Programme: 7.1.6 Pioneering the Air Transport of the Future

Area in Work Programme: AAT.2013.6-1 Breakthrough and emerging technologies for vehicles

Project content and goals:

Quantify the aerodynamic advantages of a novel low drag fuselage configuration with boundary layer ingestion.

Design and analyse an aft fuselage contra-rotating propulsion system

Validate the possibility of electrical flight and in a positive case draft a roadmap to achieve it.

Expected impact:

The EFRA concept will pave the way towards quiet and emission- free flight. In addition it offers the potential to achieve the Flight Path 2050 goals for aviation.

The anticipated lift to drag ratio of the low drag fuselage aircraft to be studied in this project is more than 25, increasing the aerodynamics efficiency by around 40%*

The increase in propulsive efficiency due to the use of novel aft fuselage contra-rotating shrouded fans with boundary layer ingestion increases the overall efficiency.

The combined gains make electrical flight a realistic possibility.

Updated information about the EASN endorsed projects and contacts can be found on the EASN website (www.EASN.net)