The consortium of the European project

AIRCRAFT INTEGRATED STRUCTURAL HEALTH ASSESSMENT II (AISHA II)

will organise an OPEN PROJECT MEETING where key results obtained within the project will be presented.

DATE:
Friday, October 28, 2011

PLACE:
Katholieke Universiteit Leuven
Leuven, Belgium
Campusbibliotheek Arenberg (C.B.A.)

AISHA II
EU- FP7 - CP 212912

Coordination of the meeting:
Katholieke Universiteit Leuven (Department MTM)

PROGRAMME

09:00 - 10:30 Session 1 (Chair: Prof. Vitaly Pavelko)

Opening by project coordinator and head of the research group 'Materials Performance and Non-Destructive Testing', MTM-SCALINT, K.U.Leuven, Prof. Dr. Martine Wevers

Prof. Dr. Martine Wevers (KUL-MTM) – 10'

Non-destructive Testing and Structural Health Monitoring (SHM) at MTM - the history and outlook for the AISHA projects

Ing. Peter Heer (Lufthansa-Technik) - 10'

General status and prospective of SHM from the standpoint of an end-user - the floor structures in airplanes as a promising user case

Dr. Helge Pfeiffer (project manager AISHA II, KUL-MTM, LHT, CTA) - 15'

Overview on the AISHA II project and the implementation of percolation sensors for leaking liquids in an operational Boeing 737 and Boeing 747 from Lufthansa

Dr. Telma Carvalho (Metalogic, LHT) - 15'

Development of an electrochemical corrosion sensor to monitor metal substrate corrosion in floor beams

Coffee break + Poster session + Demo

11:00 - 12:30 Session 2 (Chair Prof. Dr. Wolfgang Grill)

Samir Ghelam (Eurocopter) - 10'

Daily practice with Health and Usage monitoring (HUMS) versus the prospects of Structural Health Monitoring in helicopters

Dr. Wolfgang Hillger (DLR, KUL-MTM, KUL-ATF, CTA) - 15'

Advanced NDT Techniques for Damage Detection in a Honeycomb Composite Helicopter Tailboom

Ing. Iagoba Jorge Aldave (CTA, KUL-MTM, DLR, UCB - 10'

Validation tests for new SHM sensors in AISHA II.

Prof. Dr. Joseba Zubía (UCB, CTA) - 10'

Results for instant impact detection using polymer optical fibre sensors in an EC 135 tailboom.

Prof. Dr. Vitaly Pavelko (RTU, KUL-MTM, UNL) - 15'

SHM of aluminium structures, pseudo-defects and results obtained on a Mil-8 tailboom.

Light lunch + Poster session + Demonstration of full-scale tests

14:00 - 15.30 Session 3 (Chair: Dr. Wolfgang Hillger)

Ing. Stein Jannsens (ASCO) - 10'

SHM of slat tracks and analogous high lift devices – potentials for retrofit implementation and design for new aircraft

Prof Dr. Patrick Gauillaume (VUB, KUL-MTM, KUL-ATF, Cedrat, Meggit) - 15'

Options for crack detection in slat tracks – from linear/non-linear ultrasound to implemented crack gauges

Prof. Dr. Wolfgang Grill (UNL, RTU, CTA, LHT, MEGGIT) - 15'

Structural health and load monitoring in aircraft structures by high temporal resolution ultrasonics.

Prof. Dr. Christ Glorieux (KUL-ATF, ASCO, CTA) - 15'

Novel approaches of nonlinear ultrasonics in SHM

Coffee break + Poster session

15:50 – 16:50 Session 4 (Chair: Prof. Dr. Joseba Zubia)

Dr. Thomas Gesang (IFAM, MTM) - 15'

Selection of appropriate adhesives for reliable sensor implementation in SHM

Ing. Thomas Porchez (Cedrat, Meggit) - 15'

Piezo-composite patches applied to the detection of defects using Lamb wave focusing

Dr. Erling Ringgaard (Meggit, Cedrat) - 15'

The development of array transducers for SHM – composites and thick film sensors

++ Closing words ++

++ Reception ++

THE AISHA II CONSORTIUM

Katholieke Universiteit Leuven – MTM (KUL-MTM)

The research group 'Materials performance and non-destructive testing' is part of the research division SCALINT (Structural Composites and Alloys, Integrity and Non-destructive Testing) of the Department of Metallurgy and Materials Engineering of the Katholieke Universiteit Leuven. The research group is coordinated by Prof. Dr. ir. Martine Wevers,
The activities of the group address the 'long-term' material behaviour. The corrosion behaviour of materials as well as the damage development during mechanical or thermal loading is studied. The modelling of this behaviour using NDT-data is subject of the fundamental approach.
To monitor the damage development in materials, a number of non-destructive and advanced monitoring techniques are used: acoustic emission, real-time microfocus radiography, nano- and micro-computed tomography, eddy currents, ultrasound, optical fibre sensors etc.
New techniques to evaluate the nano-, micro and macro-scale damage (multiscale analysis) in polymers, ceramics, semiconductors, metals and their composites or cellular variants are used or optimised (high resolution X-ray computer tomography, the acousto-optic technique, optical fibres as smart materials...).
The research group 'Materials performance and nondestructive testing' has since many years performed research into techniques which exhibit large potential for SHM. At first the research has mainly been focussed on the acoustic emission technique, a technique which since the 1980s has been used for the detection and assessment of growing damage in metals, ceramics, polymer matrix composites, metal matrix composites, ceramic matrix composites, concrete structures etc.. Over the years, there has been a gradual evolution from traditional parameter based acoustic emission testing to AE wave exploration techniques and new AE sensors based on optical fibres. The study on optical fibres for damage detection in composite materials and the use of advanced techniques for the analysis of the detected signals resulted in a simple and robust amplitude modulated sensor for the detection of transient acoustic emission signals. This continuous evolution has made the research group one of the leading European institutions in acoustic emission testing.
Now special efforts are devoted to the development of new tools (read prototyping including sensors) for in-situ quality control during production, process monitoring and structural health monitoring.

Katholieke Universiteit Leuven – ATF (KUL-ATF)

The "Laboratorium voor Akoestiek en Thermische Fysica" belongs to the Physics Department of Katholieke Universiteit Leuven. A significant part of the research efforts, coordinated by Prof. Dr. C. Glorieux, in collaboration with (at this moment) by 3 post-doctoral researchers, 2 senior research fellows, 3 PhD students and 2 Master students, are in the field of photoacoustic and photothermal techniques and their implementation for nondestructive testing applications.

Recently, significant progress has been achieved by the ATF group concerning:

- Semi-analytical and finite difference modelling of linear and nonlinear SAW/Lamb wave - defect interaction
- Experimental scanning detection and stroboscopic interferometric imaging of SAW-defect interaction (mode conversion, reflection, transmission, diffraction)
- Use of Gabor transform for accurate determination of mode conversion coefficients at defects using difference acoustic source (periodic/line/sweep, piezo/laser) and (1D and 2D array) detection geometries

NDT and experimental and theoretical study of interaction between ultrasound and defects is one of the core activities of ATF. These will be boosted by this project, and stimulated by cross-fertilization of experience with ATF methods and experimental methods of other partners (e.g. fiber monitoring).

METALogic

METALogic is a Belgian SME company, which originated in 1991 as a spin-off company of the Katholieke Universiteit Leuven. The main competence of METALogic lies in the areas of material degradation (corrosion and environmental degradation in particular) and damage monitoring. METALogic employs 22 people, most of which are highly skilled having either an academic or industrial background. Most of its personnel has either a PhD or a technical engineering degree in areas such as materials engineering, chemical engineering, environmental engineering, welding technology, ultrasonics, artificial intelligence and software development.

Deutsches Zentrum für Luft- und Raumfahrt (DLR)

The German Aerospace Center (DLR) is an independent non-profit research establishment with the objectives to carry out research in aeronautics, space, energy, and transportation, to construct and operate large scale test facilities, to manage aerospace projects, and to serve as the German space agency. All activities are conducted in 35 research/management units located in 8 sites, and with about 4500 employees in total.
AISHA II activities are performed at the DLR – Institute of Composite Structures and Adaptive Systems (Prof. Martin Wiedemann) in the Center of Excellence "Composite Structures", which has vast experience and proven expertise in theoretical and experimental structural mechanics as well as in design and manufacturing of lightweight fibre composite structures.
The research infrastructure EXSACOM (Experimental Structural Analysis of Advanced Composites) was built up to cover the complete field of experiments on advanced composites. This includes a servo hydraulic testing field, advanced nondestructive inspection systems for high-resolution detection and characterisation of damage in composite structures, a buckling test facility as well as a THERMEX facility for thermo-mechanical loading of structural parts.

CEDRAT

CEDRAT TECHNOLOGIES SA (CEDRAT) is a high-tech SME of the CEDRAT group employing 70 people based in France close to Grenoble. CEDRAT specialises in 2 complementary fields of electric engineering such as active material applications and innovative electrical engineering. In both domains, CEDRAT designs and manufactures actuators, transducers, motors, generators, transformers and sensors as well as related electronics.

CEDRAT owns unique technologies for low-voltage piezo-actuators, piezo-structures and piezo-motors. These technologies are patented and innovative according to the patent search reports. They are also based on European PZT materials (low voltage piezo ceramics in multilayer technology). Piezo devices are available both as off-the-shelf products and as customised products. CEDRAT also masters several technologies of low-power electromagnetic rotating and linear drives, including their control/command and their power supply and is extending its activities. Considering Industrial Activities, CEDRAT exploits its patents and rights by manufacturing actuators, transducers and motors with electronics, mostly for applications related to micro-positioning, to fast positioning and to vibration generation or damping. Being initially developed for space, they are stiff, robust and efficient. They find presently customers in space, optics, aeronautics, instrumentation, telecom … Using these actuators, CEDRAT has also developed several mechanisms, for example XYZ stages for ESA, the European Space Agency, including delivery of Flight Models. CEDRAT performs also R&D activities and transfers of technologies for mass production application such as automotive industry for instance.

EUROCOPTER

Eurocopter (EC) is a wholly owned subsidiary of EADS (European Aeronautic Defence and Space Company), formed in July 2000. It is the first manufacturer of helicopters in the world, with nearly 11,100 aircraft sold to 133 countries and is specialised in the development, manufacturing and sale of helicopters, for civil and military applications (56% civil and parapublic, 44% military). Eurocopter is competing with the major North American manufacturers as Sikorsky or Bell.

Eurocopter employs 6300 persons in France (around 15 000 in the World) among of which 1200 work in Research and Development activities. The yearly research effort is about 46 000 KEuro.

Within Eurocopter, the Quality Laboratory is in charge of NDT research and gathers expertise in different technical domains as metallic, organic, tests and NDT. This laboratory is well equipped for numerous manufacturing means, mechanical tests, chemical analysis and test equipment from coupons, subassembly up to complete helicopter.

Riga Technical University (RTU)

The research activities of the Division of the Strength and the Fatigue Durability of Airframe (DSFA) are focused in the field of theoretical and experimental investigations of the strength and the fatigue of airframe materials and structures: the applied theory of fatigue fracture of rivet-joint of Al alloy aircraft structure, fatigue crack propagation, remaining lifetime and remaining strength of thin-walled structure with a damage. Laboratory of DSFA is equipped by modern test machines for static and dynamic testing of materials and structural elements. There is a stand for full scale static and dynamic test of aircraft structural component. At present time the Mi-8 helicopter tail beam is installed for fatigue test and used for investigation of problems of SHM. There is equipment and capabilities for measurement, acquisition and processing of results of ultrasonic wave propagation in a samples and structural elements. The technique of computational simulation and analysis is widely used at static and dynamic investigation of aircraft structure and its SHM.

The Aviation Institute has active collaborations with the following local aircraft industries: Kiev Mechanical Plant (Aircraft Design Bureau of O. Antonov, Ukraine), Moscow Helicopter Plant (Design Bureau of M. Mille, Russia), Aviatest Ltd. (Airframe Test Center, Latvia). The participation of the Aviation Institute will ensure a transfer of technology towards these local industries

Centro de Tecnologías Aeronáuticas (CTA)

The Centro de Tecnologias Aeronáuticas (CTA) is a Spanish non-profit making entity specialised in testing for development and certification of aeronautical and aerospace materials, components and structures with a high R&D activity. There are two operative units situated in the north of Spain: one is specialised in structural, maintenance and fire-aeronautical tests (CTA Miñano, near Vitoria), and the other, in fluid dynamics and aero-acoustic tests (CTA Zamudio, near Bilbao). The Total Human Resources are 45 (engineers, scientists and specialised technicians). The mission of CTA is the promotion of those scientific research and technological development activities, which may be of interest for the industrial environment in the aeronautical technologies field.

The Structures Department is responsible for conducting structural tests on aircraft components, both for Development purposes, to improve and optimise the design of the structure, and for Certification, in order to comply with the regulations or standards of the pertinent Authorities.

The main tests carried out are:

Development: - *Rigidity and static strength*

- *Endurance*

Certification: - *Static strength (limit load, ultimate load)*

- *Fatigue testing: safe life, damage tolerance, economic life.*

The main customers are: AERNNOVA, EMBRAER, EADS- SOCATA, AIRBUS, CESA, ITP, ….

MEGGIT

Ferroperm Piezoceramics A/S is part of MEGGIT and is has 40 years of experience in manufacturing high-quality piezoelectric ceramics. InSensor was formed in 2004 with the purpose of addressing the promising market of integrated sensors and transducers based on piezoceramic thick film. It is located in the production facility of Ferroperm Piezoceramics and shares its entire staff with the mother company. Thus it builds upon Ferroperm's long tradition of state-of-the-art products combined with a dedication to constant development.

Ferroperm Piezoceramics A/S is a research-intensive Danish SME (50 employees, 9 of whom are engineers) with the ability to develop new materials all the way to the production stage – often in close collaboration with users of piezo¬ceramic trans¬ducers and designed for special applica¬tions – and offers a very wide standard material pro¬gramme. The company has specialised in fulfilling individual requirements of customers, such as the manufacturing of piezoelectric ceramics for their four strategic markets: Vibration Sensors, Medical Diagnostics, Flowmeters and Underwater Acoustics. A wide range of materials, shapes and sizes are available

The RTD facilities include a fully equipped powder laboratory (mixed oxide process) and comprehensive electrical characterisation equipment. There is a strong collaboration between the R&D department and the production, and in practice the R&D staff will use the normal production facilities for the manufacture of the ceramic parts (allowing easy upscaling).

Ferroperm has a long standing commitment to R&D and currently spends 15 to 20 % of its turnover on R&D projects. There is a close collaboration with leading universities throughout Europe, both concerning material development and applications. Ferroperm has continuously been involved in a variety of European projects under Brite/Euram, Eureka, CRAFT, Esprit, FP5, FP6 etc.

Research topics include high-temperature piezoelectric ceramics, high-sensitivity materials, lead-free materials and thick-film technology. Ferroperm was the coordinator of POLECER, a thematic network on polar electroceramics (within GROWTH, FP5), which had 70 members from all over Europe, and the company is currently coordinating the project MINUET (NMP2-CT-2004-505657) and the MIND Network of Excellence (administrative coordinator), both within FP6.

ASCO

ASCO Industries nv is a world leader in the design and manufacturing of high precision, hard metal, structural components for the aeronautical industry. It specialises in difficult to machine materials such as maraging steels and titanium alloys and supplies to all major aircraft manufacturers worldwide (Airbus, Boeing, Canadair, Embraer, Dassault, etc.). Production includes parts used in such safety critical areas as the leading and trailing edge of the wings, engine mounts and landing gear.
Asco has 25 years of experience in the manufacturing of components for the aeronautical industry. This implies we are fully certified (including ISO 9000 and Boeing advanced quality certification) to meet all the restrictions demanded in this industry.
Since 5 years our expertise has been expanded with product development (including design responsibility for the leading edge mechanism for the A380 and the trailing edge mechanism for the A400M) and development testing.

Fraunhofer Institute IFAM

The Fraunhofer-Gesellschaft is the leading organization for institutes of applied research in Europe. It currently operates 56 research institutes and employs about 12,500 people at various sites throughout Germany. Most of the annual research budget of about 1200 million € is directed at contract research for both private industry and public sector.

The Fraunhofer Institute for Manufacturing Technology and Applied Materials Research (IFAM) – Adhesive Bonding Technology and Surfaces – in Bremen is the largest independent research organization in Europe in the area of industrial adhesive bonding technology. More than 120 employees are actively engaged in research and development work, with the goal to develop application-orientated bonding system solutions for industry. The work of the institute extends from fundamental research through to manufacturing and on to the

market introduction of new products. Industrial fields of application are in plant engineering, vehicle manufacture and micro-assembly and in the packaging, textile and electronics industries. Meeting the challenges of IFAM's customers requires a detailed understanding of the chemical and physical properties of surfaces, interfaces and coatings. These properties largely determine the long-term stability and strength of bonded joints and the adhesion and reliability of organic coatings. The Fraunhofer IFAM possesses facilities for surface and structure analysis, for electrochemistry and for computational materials modelling.

University of Leipzig (UNL)

UNIVERSITÄT LEIPZIG

The Department of Solid State Optics and Acoustics at the University of Leipzig is focused on the study of the optical and mechanical properties of solids. In applied sciences, imaging by light and ultrasonic waves including confocal optical microscopy and phase sensitive acoustic microscopy down to 1 µm resolution as well as ultrasonic holography and tomography is performed–including the development and realization of novel monitoring and imaging schemes. State of the art equipment has been developed and is available for ultrasonic imaging and monitoring. For applications in the regime of guided ultrasonic waves we have developed under contract of the European Space Agency (ESA) the detection schemes and the prototypes for the detection of the solid liquid interface for directional solidification experiments in the Materials Science Laboratory (MSL) of the International Space Station (ISS). Joined industry projects concerning ultrasonic monitoring include co-operations under contract with EADS (Europe), Schott AG (Mainz), Kayser-Threde GmbH (Munich), PFW (Pfälzer Flug-technische Werke) Technologies GmbH (Speyer).

Vrije Universiteit of Brussels (VUB)

The Vrije Universiteit Brussel is a medium-sized university, with some 9000 registered students. About 1800 VUB-students are from outside Belgium, of whom about 800 come from Asia, Africa and South America. It is situated close to the heart of Brussels. The VUB intends to make its presence felt even more by consciously working to transcend existing barriers and contradictions so as to constitute an important Brussels hub for research and information. (Munich, Madrid, Hamburg, Copenhagen, Marseille) travel on SN operated flights and aircraft.

The major contribution of the Acoustics and Vibration Research Group of the department of Mechanical Engineering of the VUB is contained in the testing of complex aircraft structures and the validation of the developed on-line monitoring techniques based on ultrasonic "multisine" surface acoustic waves. These extensive tests, which will be performed at the VUB, will also generate important feedback with respect to practical implementation/optimisation of the developed methodologies and its position with respect to classical NDT techniques.

University of Basque Country (UBC)

The research group "Applied photonics group" belongs to the Department of Electronics and Telecommunications of the University of the Basque Country, at Bilbao, Spain. Our group is composed of 1 full professor, 2 associate professors, and three lecturers. At this moment we have 2 PhD students and 10 students doing the final engineering project with us.

We are involved in the fiber optics working group of ARINC to develop the standards related with fiber optics in avionics. These ARINC specifications are dedicated to fiber connectors, fiber cables, installation procedures, system design, optical test procedures and training.

Our research group has been studying optical communications and fiber optic sensors issues. In the last years we have initiated several projects with some companies and research institutions such as CTA and AERNOVA (former GAMESA AERONAÚTICA) to use optical fibers in aircrafts for both, communications and sensing. This includes mechanical testing of optical components, sensors and systems.

Lufthansa Technik (LHT)

Lufthansa Technik AG is one of the world's leading providers of aircraft maintenance, repair and overhaul (MRO) services. xpertise advantage through worldwide customer base: Long gone are the days when Lufthansa Technik's expertise advantage stemmed solely from its support of Lufthansa's flight operation. The company now serves customers all over the world: airlines large and small, charter carriers, operators of VIP aircraft, airlines whose aircraft have to fly under extreme climatic conditions, or whose aircraft are subject to the strain of short-haul traffic with frequent takeoffs and landings. More and more airlines are outsourcing some or all of their fleet maintenance and overhaul to external specialists with strong technical know-how. They seek a partner with a wide range of skills that can assist them in every aspect of service and provide them with true added value – with everything they need coming from a single source, including engineering and logistics.

Poster session

Every visitor is invited to present posters related to structural health monitoring of aircraft or related non-destructive testing applications (Please mention it when you register to the open project meeting)

Live presentations of structural health monitoring systems

- **Detection of corrosive liquids in floor structure of aircraft**
  Using a digital multimeter, the ingress of liquid in aircraft structures can be monitored by a floor structure sensor. A similar system was implemented in a Boeing 737 within the project

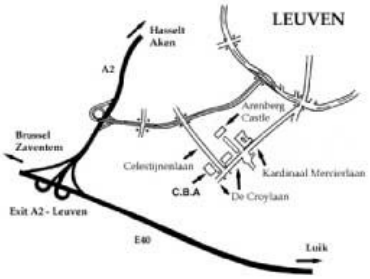
- **Helicopter tail boom demonstrator EC135**
  Detection principle for active and passive impact detection in composite using piezoelectric transducers and optical fibres sensors

- **Slat track of an Airbus A 320**
  Detection of the growth of artificial cracks using piezoelectric sensors.

Travel and Accommodation

For assistance concerning travel or accommodation, please contact Aniko Lantos, Kasteelpark Arenberg 44, 3001 Leuven,
Aniko.Lantos@mtm.kuleuven.be Tel: +32 /(0)16 32 13 00, Fax: +32 /(0)16 32 19 90

Address of venue:



Campusbibliotheek Arenberg (C.B.A.)
Willem de Croylaan 6
3001 Heverlee

Registration

Please subscribe via email Ioannis.Pitropakis@mtm.kuleuven.be before 24th of October 2011, if you want to present a poster, before the 18th of October.

www.aisha2.eu

ATF Katholieke Universiteit Leuven

METALogic

DLR DEUTSCHES ZENTRUM FÜR LUFT-UND RAUMFAHRT

CEDRAT TECHNOLOGIES

eurocopter an EADS Company

RTU Riga Technical University

CTA FUNDACION CENTRO DE TECNOLOGIAS AERONAUTICAS

InSensor A/S Meggitt - Ferroperm

asco ASCO INDUSTRIES

Fraunhofer IFAM Manufacturing Technology and Applied Materials Research

UNIVERSITÄT LEIPZIG

VRIJE UNIVERSITEIT BRUSSEL Free University of Brussels - VUB

University of Basque Country

Lufthansa Technik