Integrated design and product development
The CREDO objective is to supply new hybrid inverse procedures for faster and more accurate model parameter calibration and updating. The link with the design procedure will be demonstrated from the local level up to the complete simulation of flight conditions, with the inverse computation being an integral part of the calibration procedure.

Project Consortium
- Università Politecnica delle Marche (Coordinator)
- Alenia Aeronautica S.p.A
- Brno University of Technology
- Brüel&Kjaer Sound and Vibration Measurement A/S
- Dassault Aviation
- Deutsche Zentrum für Luft und Raumfahrt e.V.
- EADS Innovation Works
- Ecole Centrale de Lyon
- Eurocopter Deutschland GmbH
- Free Field Technologies
- Université du Maine – Laboratoire d’Acoustique
- Odegaard & Danneskiold-Samsoe A/S
- Politecnico di Milano
- Università di Napoli Federico II
- Agusta Westland S.p.A

Manufacturing
Quality Control for small-medium sized aircraft (e.g. business jets) in order to fix manufacturing errors and eliminating the noise sources (e.g. sound proofing materials not properly mounted) is very difficult to perform, the CREDO techniques significantly improves this situation, allowing for fast and accurate ground and flight tests.

Maintenance
In many cases maintenance operations are connected with noise trouble shooting (e.g. undesired noise to be suppressed in aging aircrafts). The new experimental techniques permit to deal with these problems with higher accuracy, in a shorter time and with reduced costs.

Structural weight reduction
For both aircraft and helicopters, the introduction of new lighter structures for weight reduction poses important interior noise issues. CREDO supplies tools to support appropriate measures which consider acoustic design without losing the benefits of weight reduction and cost saving.

Cabin Noise Reduction by Experimental and Numerical Design Optimisation

SPECIFIC TARGETED RESEARCH OR INNOVATION PROJECT
AERONAUTICS AND SPACE
July 2006-June 2009
DISSEMINATION MEETING
17TH APRIL 2009
PRAGUE
Best Western Hotel Kampa

Contacts:
Coordinator:
Prof. Enrico Primo Tomasini
e.p.tommasini@univpm.it

Technical Staff:
Gian Marco Revel
gm.revel@univpm.it
Milena Martarelli
m.martarelli@univpm.it

Secretariat:
Giulia Sbano
g.sbano@univpm.it
Local reverberant field measurement and processing algorithms based on microphone array methods

At frequencies up to 5 kHz, where the sound field is most reverberant, the panel scattering properties (absorption coefficient or surface admittance) must be first either specified or measured using carefully designed artificial excitation by loudspeakers. These scattering properties are then used to separate the sound energy flows due to absorption and panel radiation from in-flight measurements. A new system, based on Double Layer Array and patch Near-field Acoustic Holography, has been developed for the measurements of the acoustic field. Also arrays of p-u probes have been used to determine the radiated sound intensity in the cabin environment.

RESEARCH AREAS

Local reverberant field measurement and processing algorithms applicable at high frequencies

At higher frequencies (e.g. above 1000 Hz), where the acoustic absorption in the cabin is greater, complementary methods based on 3D beam-forming technologies have been developed.

Coupling of scanning laser Doppler vibrometry local measurements with reverberant acoustic field local measurements

Scanning laser Doppler vibrometry (LDV) directly measures the vibration of surfaces in the cabin and thus does not suffer deterioration due to the reverberant sound field. For the same reason, however, it can not be used on its own for the determination of the sound power entering the cabin. Therefore, it has been used in parallel with the NAH approach results in models that are specific to a particular cabin application.

APPLICATION AREAS

- Aeronautics and Space
- Sound Package Industry
- Transportation sector (automotive vehicles, trains, ships etc)
- Civil buildings

CREDO - ‘Cabin noise Reduction by Experimental and numerical Design Optimization’ is a Specific Targeted Research or innovation Project (STREP) within the 6th European Framework Programme, Priority [4] Aeronautics and Space, and it is coordinated by the Dept. of Mechanics, Università Politecnica delle Marche (It). Motivated by the aircraft industry’s acute need to validate and calibrate prediction models and advanced design tools for the cost-effective design of low-noise cabins, the CREDO project addresses a critical deficiency in the available data by developing technologically viable experimental procedures and analytical tools by which the sound power entering an aircraft cabin can be determined sufficiently quickly, accurately and with the necessary spatial resolution. Owing to the reverberant nature of the sound field in an aircraft cabin, existing methods are categorically insufficient for this task and entirely new methods shall be developed. The successful implementation of the results of these developments is ensured by a carefully designed validation campaign involving ground and flight tests in both aircraft and helicopter cabins.

GENERAL DESCRIPTION

The CREDO project will achieve its objective by pursuing two mutually interdependent technical tracks:

1) Local measurement and processing algorithms, which require, at most, only local acoustic characteristics for the determination of the entering power. No large scale modelling of the aircraft cabin is required and as such the development is entirely generic and may be applied in any reverberant environment. A local approach is, for example, the determination of the accurate entering acoustic power from a single window in flight.
2) Global measurement procedures and associated processing using inverse numerical methods, in which an account of the reflections in the aircraft cabin is made by building a global experimental and numerical model of the whole or a large part of the cabin interior and then inverting from measured sound data to the required entering sound power. In contrast to the local, generic approach, this global approach results in models that are specific to a particular cabin application.

INVOLUTION CONTRIBUTIONS

- to improve understanding on the noise generation and propagation phenomena;
- to improve the efficiency and reduce time in the whole design procedure;
- to improve accuracy in numerical simulation;
- to improve efficiency, reduce time and costs in all acoustic tests;
- to have tools to handle noise problems in general with higher performances and lower costs applicable for all the kind of aircraft and helicopter cabins.

Flight test techniques and related measuring technologies

The CREDO introduces advanced tools for efficient and time-saving flight testing. The quality of the data permits in-flight research to be performed at the same time, including innovative inverse modelling for data post-processing. This opens up several important possibilities: direct and efficient evaluation of new configurations, materials and new passive and active solutions; fast trouble shooting in existing aircrafts and helicopters to fix manufacturing errors; acoustic quality control for new aircrafts before delivering to the customer, time and cost reduction in flight tests, etc.. The proposed tools are easy to be managed, fast and completely non-intrusive.

APPLICATION AREAS

- Aeronautics and Space
- Sound Package Industry
- Transportation sector (automotive vehicles, trains, ships etc)
- Civil buildings

formalised, it allowing to compute the vibrational/acoustic energy of each subsystem of complex structures (as Statistical Energy Analysis techniques, SEA) and also the local space spread of energy density within the subsystems.

Vibration and Coherent acoustic intensity distributions
"Cabin Noise Reduction by Experimental and Numerical Design Optimisation"

Dissemination Meeting Agenda
17th April 2009 Prague
Best Western Hotel Kampa

9:00 Introduction by the host Partner Brno University of Technology Prof. Radimir Vrba - FEEC
9:15 Presentation of Credo Project by the Coordinator Prof. Enrico Primo Tomasini - Università Politecnica delle Marche
9:35 Point of view of the European Commission – Dr. Ing. Dietrich Knörzer DG Research-H.3 Aeronautics
9:45 The activities of the European Aeronautic Scientific Network - Prof. Ing. Pistek

Local and Global Techniques Development
10:00 Local measurement and processing methods for the determination of the entering acoustic power into the cabin – Dr. Jorgen Hald, Bruel&Kjaer
10:30 Global measurement procedures and associated processing techniques based on inverse numerical methods – Eng. Antonio Paonessa, Alenia Aeronautica

11:00 coffee break

Application and Integration of the Developed Techniques
11:30 Application to aircraft cabins – Dr. Pierre Hardy, Dassault Aviation
12:00 Application to helicopter cabins – Dr. Alexander Peiffer, EADS
12:30 Discussion on results, possible application and development – Dr. GianMarco Revel, Univpm

13:00 lunch

14:00 Exhibition with demonstration of developed techniques