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AERONAUTICS RESEARCH

2003 - 2006 PROJECTS

PROJECT SYNOPSES – VOLUME 1

RESEARCH PROJECTS FROM THE FIRST AND SECOND CALLS

PROJECT SYNOPSES

SIXTH FRAMEWORK PROGRAMME

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How to use this book

This book contains the synopses of all of the aeronautics and air transport projects under the first and second calls (Calls 1A, 2A, 1B) for proposals of the Sixth Research Framework Programme (FP6) of the European Commission.

The synopses are intended to provide a brief overview of project objectives, technological approaches and expected achievements. Some administrative features and partnership details are also given, allowing for a more comprehensive description of the projects. The names and addresses of the project co-ordinators are provided, should any further information be required. The project synopses are presented in four blocks representative of the four areas of the Aeronautics work-programme.

Also included in the book are lists of National Contact Points and contact details of the Commission staff involved in aeronautics and air transport. A list of abbreviations is intended to assist the reader in understanding the notation used in throughout the book, especially country names, institutions and widely used technical terms.

In addition, two indexes at the back of the book allow the identification of projects by contract number and by project acronym. Finally, an alphabetical index of all project participants gives the page number of every project in which the participant is involved.

The European Commission would like to thank the project coordinators for their replies to requests for photographs to complement the text of this publication.

Foreword

Aeronautics is a highly strategic sector for Europe, bringing citizens closer together and generating knowledge, skills, wealth and jobs. The industry is essential for economic growth and is a key factor in the effort to make Europe the most competitive and dynamic knowledge-based economy in the world.

An area of recognised strength for Europe, aeronautics has become a symbol of technological and industrial prowess and of what we can accomplish when we work together. The European aeronautics industry has proved itself to be rather successful in recent years, and this is without doubt the result of trans-European teamwork and Community research has had a major role to play in this, acting as a powerful catalyst to bring the important players together around common objectives. It is therefore with great pleasure that I introduce this synopsis of the aeronautics research carried out within the Thematic Priority 'Aeronautics and Space' of the Union's Sixth Research Framework Programme (FP6).

In 2000, the 'Group of Aeronautics Personalities' put forward its 'Vision 2020' for aeronautics in Europe, establishing the basic goal of meeting society's needs while ensuring industrial competitiveness. Attaining this goal means rising to some formidable challenges. Europe must respond to a rapidly growing air transport market while balancing environmental, safety, security and capacity demands – all of this in the face of growing global competition from both traditional and emerging players. Now, more than ever, new and advanced technological solutions are called for and Europe must work together to find them.

The Advisory Council for Aeronautics Research in Europe (ACARE) was the first of the new Technology Platforms for European research. It has provided strong impetus by involving all stakeholders and by putting forward an ambitious and evolving Strategic Research Agenda (SRA), based on the 'Vision 2020' goal of meeting society's needs while ensuring industrial leadership. Under FP6, European aeronautics research has closely followed the ACARE SRA.

European Commission projects in aeronautics are undertaken by the Directorate-General for Research, focusing on technologies and airborne aspects, and the Directorate-General for Transport and Energy, addressing mainly ground-based air transport elements. The Community budget for aeronautics research has increased steadily under the Framework Programmes, reflecting the increasing importance of the sector for economic growth. This trend is expected to continue, with a substantial share going to research instruments of greater scale and scope, such as integrated projects.

The recent enlargement of the European Union has brought in ten new Member States, many of which have strong national aeronautics traditions. The integration of these new partners within the European Research Area is far from complete, but they are certain to play an increasingly important role in the future of European Aeronautics research.

I am confident that this synopses book will provide an interesting and useful overview of our joint efforts in support of the future of European air transport.

Janez Potočnik
European Commissioner for Research

The importance of the aviation industry

Europe's air transport system of is vital for the growth of the entire European economy and for the cohesion of the Union and its regions. In addition to its role in facilitating economic activity, European air transport, including the aeronautics manufacturing industry, represents a significant economic factor in its own right. Altogether, it contributes about €500 billion (2.6%) to Europe's Gross Domestic Product (GDP).

Some key air transport figures

- 3.1 million Jobs (1.9% of all jobs in the EU)
- 130 airlines
- 450 airports
- 5000 aircraft fleet
- 1 billion passengers per year
- 12 million movements per year

The aeronautics manufacturing industry is of great strategic importance to Europe and its Member States. Due to its high investment in research and development, the industry, including its entire technology supply chain, plays a significant role in the high-skill labour market and acts as a catalyst for many high-tech developments.

Key figures of the aeronautics manufacturing industry for 2003

– Turnover:	€74 billion
– New jobs:	415 000
– Exports:	53% of total production
– Trade surplus:	€2.2 billion
– Operating profit:	5.3% of turnover
– R&D expenditure:	14.5%

An estimated 14 000 new aircraft will have to be built and sold over the next 15 years to satisfy the expected growth in demand for air travel. This could mean an income of more than €500 billion for European industry, if Europe can maintain just a 50% share of the market.

Europe can undoubtedly achieve this kind of leading position in a sector now widely seen as crucial for sustainable economic growth. But it can do so only by supporting and promoting ongoing collaborative

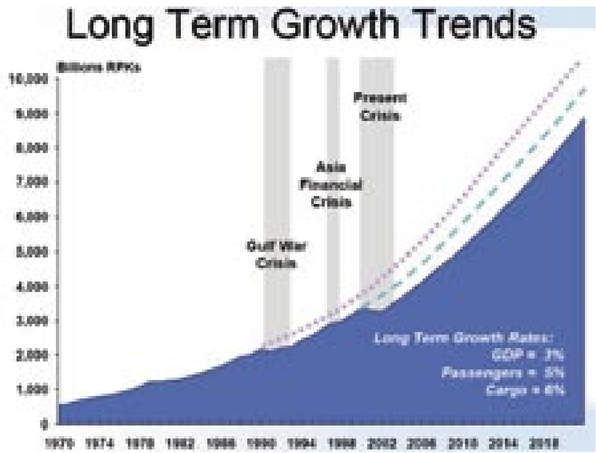


Figure 1: Long-term growth perspective of global air transport

Source: US Department of Trade

research and technological development efforts and by further expanding these efforts to include every existing and potential European aeronautics stakeholder.

Society's growing transport needs

Despite recent setbacks, market forecasts indicate the demand for air transport will continue to grow at an average rate of about 5% per year. The most dramatic effects will be seen in developing countries, most notably China, where the estimated 9% GDP growth rate will manifest itself in a huge emerging market for air travel and shipping.

This will present some major challenges in terms of operational capacity, acceptable safety levels and environmental impact. In addition, given current world political tensions, security now features strongly as a factor in air transport.

The European Research Area and aeronautics

The term 'European Research Area' (ERA) refers to the European Union's declared ambition of achieving a genuine common research policy. This includes the integration of Member States' scientific and technological capacities.

Europe has a long-standing tradition of excellence in research and innovation – indeed European teams continue to lead the way in many fields of science and technology. However, its centres of excellence are scattered across a growing number of Member States, leading to fragmentation and an absence of adequate networking and communication.

In the past, collaborative actions have been initiated at the transnational and EU levels, but Europe's research efforts need to be better channelled, better organised, to provide a structure for research and innovation equivalent to the 'common market' for goods and services. This structure is the ERA. It represents a new beginning for European research, comprising a coherent and concerted approach, stimulating the development joint strategies across the EU.

With ERA, Europe provides itself with the resources it needs to fully exploit its exceptional potential, moving towards its goal of becoming what the Lisbon European Summit (March 2000) called 'the world's most competitive and dynamic knowledge-based economy' by 2010.

The new sense of purpose and energy provided by ERA has also been a valuable impetus to the aeronautics industry, reinvigorating research activities being undertaken both within and among all Member States of the Union.

Vision 2020 and the Strategic Research Agenda

In 2000, then Commissioner for Research Philippe Busquin chose the aeronautics sector as a model for the emerging ERA. He assembled the 'Group of Aeronautics Personalities', comprising 14 senior members of the sector, their goal to postulate European ambitions regarding the future of aeronautics. The result was the seminal 'Vision 2020' report, published in January 2001. Two top-level objectives were laid out in the Vision:

- Meeting society's needs, in terms of demand for air transport, travel fares, travel comfort, safety, security and environmental impact; and
- Ensuring European leadership in the global civil aviation market, by enabling it to produce cost-effective, operationally attractive and, performance-wise, highly efficient products at the pinnacle of current technologies.

The Group recommended the creation of the 'Advisory Council for Aeronautics Research in Europe' (ACARE), whose role was to define and maintain a Strategic Research Agenda (SRA), a roadmap for research into new technologies identified as critical to fulfil the objectives of the 2020 Vision. Some of the ambitious goals for 2020, as defined in the SRA, taking the state of the art in the year 2000 as a reference point, are as follows:

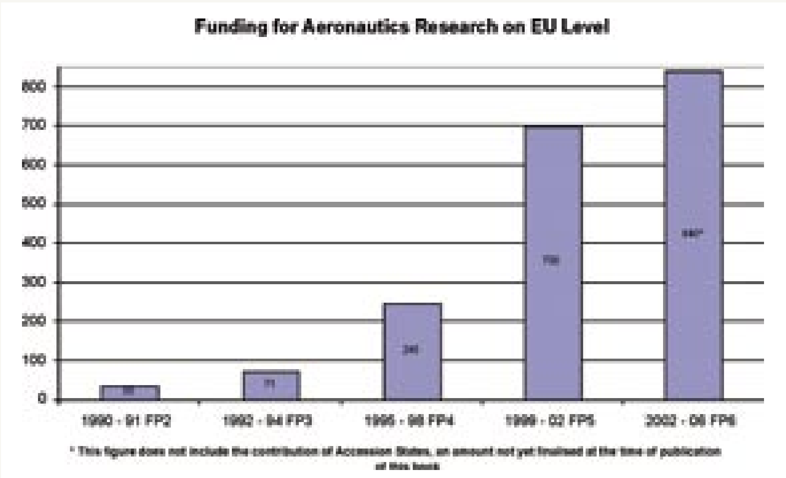
- 80% reduction in NOx emissions
- Halving of perceived aircraft noise
- Five-fold reduction in accidents
- An air traffic system capable of handling 16 million flights per year
- 50% cut in CO2 emissions per passenger kilometre
- 99% of flights departing and arriving within 15 minutes of scheduled times

The SRA provided the guidelines and detailed objectives that helped shape the aeronautics research programme of the EU's Sixth Research Framework Programme (FP6). A second edition of the SRA was published in March 2005, building upon and extending the original SRA and illustrating the dynamic fashion in which the Agenda continues to develop and evolve.

The aeronautics research programme also adheres to guidelines set out in the Lisbon strategy and in the Transport White Paper, entitled 'European Transport Policy for 2010: time to decide'. This document is similar to Vision 2020 report but covers all transport modes. It describes the overarching goals of improving the contribution of transport systems to society and industrial competitiveness within an enlarged EU, whilst minimising the negative impact and consequences of transport in relation to the environment, energy usage, security and public health.

Aeronautics research in the Framework Programmes

Specific aeronautics research at the European level was first introduced in 1989, under FP2, in the form of a pilot phase. Since 1990, the EU has supported some 350 projects, representing a total research expenditure of about €4 billion, approximately 50% of which has been funded by



the EU. The average size of projects has varied between €2 and €8 million. However, the recent trend has been to fund research projects of dramatically broadened scope and scale, including some 25 larger projects representing expenditures of up to €100 million.

The focus of the FPs has changed over time, reflecting the evolution of the programme, from modest beginnings to the current status:

- FP2 (1990-91), budget €35 million: a pilot phase aimed at stimulating European collaboration
- FP3 (1992-95), budget €71 million: a consolidation phase with emphasis on key technical areas
- FP4 (1995-98), budget €245 million: focused on industrial competitiveness with increasing emphasis on subjects of wide public interest
- FP5 (1999-02), budget of €700 million: a specific key action aimed at industrial competitiveness and sustainable growth of air transport
- FP6, budget of €840 million: part of the 'Aeronautics and Space' thematic priority, with equal focus on issues of public interest and industrial competitiveness

The EU programme now contributes an estimated 30% of all European public funding of civil aeronautics RTD. Public funding, in turn, represents only 10% of the total spent in civil aeronautics RTD in Europe.

Aeronautics research under FP6

Scope

EU aeronautics research follows an all-encompassing, global approach to commercial aviation, focusing not only on the improvement of aircraft technologies but also on the infrastructure of the operational environment.

The programme covers commercial transport aircraft, ranging from large civil aircraft to regional and business aircraft and rotorcraft, including their systems and components. It also encompasses airborne and ground-based elements of air traffic management and airport operations. The EU does not fund military aeronautics research.

Main research areas

Aeronautics research activities are divided into four general areas:

1. Strengthening competitiveness (of the manufacturing industry)

Objectives:

- Reducing development costs by 20% and 50% in the short and long terms, respectively
- Reducing aircraft direct operating costs by 20% and 50% in the short and long terms, through improved aircraft performance, reduction in maintenance and other direct operating costs
- Increasing passenger choice with regard to travel costs, time to destination, on-board services and comfort

2. Improving environmental impact with regard to emissions and noise

Objectives:

- Reducing CO_2 emissions (and fuel consumption) by 50% per passenger kilometre in the long term, through improved engine efficiency as well as improved efficiency of aircraft operation
- Reducing NOx emissions by 80% in the landing and take off cycle and conforming to the NOx emissions index of five grams per kilogram of fuel burnt while cruising in the long term (10 gr. per kg. in the short term), and reducing other gaseous and particulate emissions
- Reducing unburned hydrocarbons and CO emissions by 50% in the long term to improve air quality at airports
- Reducing external noise by four to five dB and by 10 dB per operation in the

short and long terms, respectively. For rotorcraft, the objective is to reduce the noise footprint area by 50% and external noise by six dB and 10 dB over short and long terms.
- Reducing the environmental impact of the manufacture and maintenance of aircraft and their components

3. Improving aircraft safety and security

This means ensuring that, irrespective of the growth of air traffic, there will be fewer accidents and aircraft will be more secure against hostile actions. Overall objectives include:

- Reducing the accident rate by 50% and 80% in the short and long terms, respectively
- Achieving 100% capability to avoid or recover from human errors
- Increasing the ability to mitigate consequences of survivable aircraft accidents
- Reducing significant hazards associated with hostile actions

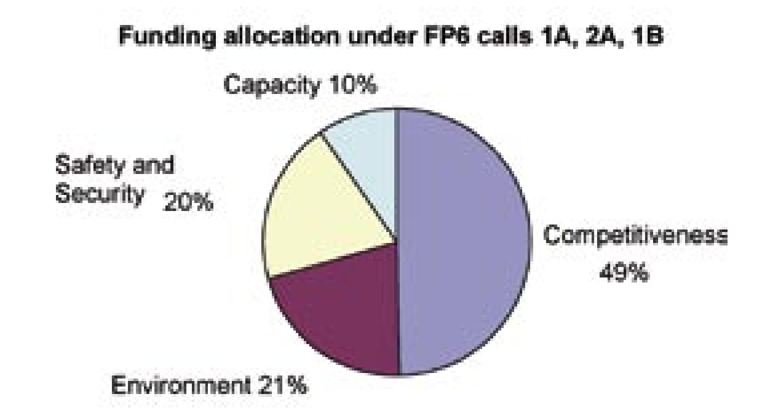
4. Increasing the operational capacity of the air transport system

This entails major changes in the way air traffic services are provided. Overall objectives include:

1. Improving safety, taking into account projected traffic levels, by providing better information on surrounding traffic to both pilots and controllers
- Increasing system capacity to safely handle three times the current air movements by 2020, through an improved planning capability, coupled with a progressive distribution of tasks and responsibilities between aircraft and ground facilities
- Improving system efficiency and reliability, aimed at achieving an average maximum delay of one minute per flight
- Maximising airport operating capacity in all weather conditions through improved systems to aid controllers and pilots

The pie chart below reflects an even split between the two overall objectives of Vision 2020: ensuring European leadership of the industry by strengthening competitiveness; and meeting society's needs by addressing environmental, capacity, safety and security concerns.

It must be emphasised that many projects cannot be classified as belonging solely to one research area, e.g. maintenance has a significant impact on competitiveness just as it has on safety, and aerodynamics, propulsion, structures and materials



are all essential for making aircraft not only competitive but also environmentally friendly. In real-world terms, the division between the four main research areas is, to some extent, arbitrary.

The way the projects have been categorised in this book is therefore also somewhat arbitrary. It reflects only one possible classification scheme, albeit a generally acceptable one, with each project classified within an agreed most relevant domain.

The online version of this publication will provide a more dynamic picture of the interconnectedness of aeronautics research, with many projects aimed at multiple specific objectives touching different main research areas.

The role of the Aeronautics Advisory Group

With respect to the implementation of FP6, expert groups are needed to advise the Commission on the overall strategy to be followed in carrying out research and activities within the priority thematic areas as well as on orientations vis-à-vis the European Research Area.

In broad terms, the 'Aeronautics Advisory Group' contributes to the successful implementation of FP6 and to the creation of a European Research Area, working with Commission services by helping to stimulate the corresponding European research communities. The group carries out its work in full knowledge of the European research policy context, and of the research activities carried out at the national level.

More specifically, the group has a specific mandate based around the following tasks:

– Provide input to the definition of the work programmes and their updates.
– Make recommendations in the related discussions aimed at steering programme development within the context of the European Research Area strategy.
– Assist, where needed, in the development of strategic visions on a European scale for the subject fields addressed
– Comment on the strategic nature and exploitation of the proposed work to be carried out.

FP6 research instruments

The new instruments introduced under FP6 are based on the concepts of the European Research Area and are aimed at more effectively structuring and integrating European research. For aeronautics, the new instruments include the 'Integrated Project' (IP) and the 'Network of Excellence' (NoE).

Integrated Project

Multiple partner projects to support objective-driven research, where the primary deliverable is knowledge for new products, processes, services etc. IPs should bring together a critical mass of resources to reach ambitious goals aimed either at increasing Europe's competitiveness or at addressing major societal needs.

Network of Excellence

Multiple partner projects aimed at strengthening excellence on a research topic by networking a critical mass of resources and expertise. This expertise will be networked around a joint programme of activities aimed primarily at creating a progressive and lasting integration of the research activities of the network partners while, at the same time advancing knowledge on the topic.

Traditional instruments are also retained under FP6, including the 'Specific Targeted Research Project' (STReP), the 'Coordination Action' (CA) and the 'Specific Support Action' (SSA).

Specific Targeted Research Project

Multiple partner projects whose purpose is to support research, technological development and demonstration or innovation activities of a more limited scope and ambition, particularly for smaller research actors and participants from new Member States and associated and candidate countries.

Coordination Action

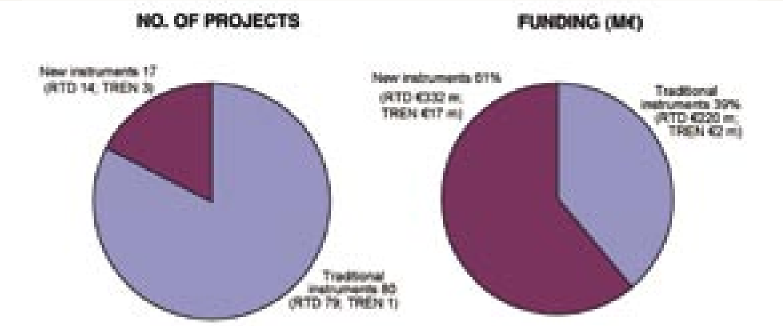
Promoting and supporting networking and coordination of research and innovation activities, covering the definition, organisation and management of joint or common initiatives as well organising conferences, meetings, the performance of studies, exchanges of personnel, exchange and dissemination of best practice, setting up common information systems and expert groups.

Specific Support Action

Single or multiple partner activities intended to complement the implementation of FP6 and/or to help in preparations for future Community research policy activities. Within the priority themes, they support, conferences, seminars, studies and analyses, working groups and expert groups, operational support and dissemination, information and communication activities, or a combination of these.

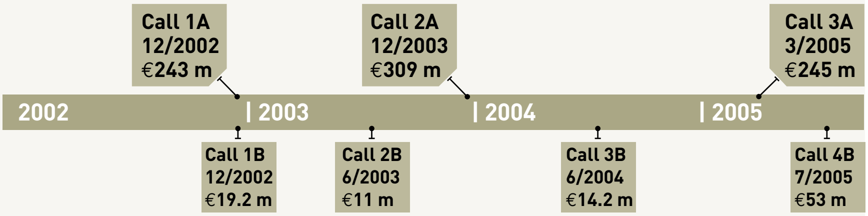
Instrument	Purpose	Primary deliverable	Project scale
Integrated Project (IP)	Objective-driven research	Knowledge	Medium-high
Network of Excellence (NoE)	Tackle fragmentation	Structuring	Medium-high
Specific Targeted Research Project (STReP)	Research	Knowledge	Low-medium
Coordination Action (CA)	Coordination	Coordination	Low-medium
Specific Support Action (SSA)	Support	Support	Low

FP6 (Calls 1A, 2A, 1B, excluding SSAs) total numbers of projects and funding



Traditional instruments: STReP, CA, SSA; and new instruments: IP, NoE

FP6 call roadmap



Note 1: calls 1A, 2A and 3A are managed by the Research Directorate-General (RTD) while calls 1B, 2B, 3B and 4B, dealing with ground-based air traffic management and airports are managed by the Transport and Energy Directorate-General (TREN). Amounts shown are indicative and vary on finalisation of subsequent contracts.
Note 2: This edition of the book includes only the projects selected form Calls 1A, 2A and 1B.

The selection process

A panel of independent experts evaluates submitted proposals, thereby assisting the Commission in the process of project selection. Experts are highly experienced in the specified research area and have a good overview of both the social and innovation issues.

Evaluators look at the proposals individually, comparing them with the main evaluation criteria for the type of instrument. Proposals that pass the individual evaluation phase are then submitted to an extended evaluation in which they are prioritised, depending on the available budget. The Commission moderates the decision process of an 'extended panel', consisting of selected experts. The Commission is not obliged to follow the recommendations of this panel, but does have to justify its decisions.

The pre-defined main selection criteria depend on the type of instrument a given proposal applies to. All projects have to be relevant to the objectives of the Programme and their potential impact must be apparent. Proposals must demonstrate good quality of project management, a crucial factor for mission success, and adequate mobilisation of resources to achieve the critical mass needed to carry out a project.

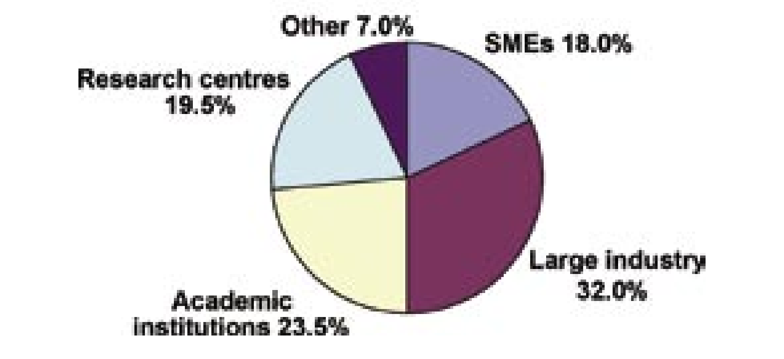
Scientific and technological excellence is especially important for the technical aspects of IPs and STRePs. Quality of coordination is more crucial for CAs, while degree of integration is an indicator of potential success in creating an NoE. The quality of the consortium must also be taken into account when assessing any type of instrument, and, especially in the case of NoEs, all participants must demonstrate a high level of excellence.

EU funding under FP6 covers up to 50% of eligible costs for research and industrial participants. For academic institutions, up to 100% of additional costs are covered. NoEs, CAs and SSAs are normally provided financing of up to 100% of actual costs.

Participation

FP6 (Calls 1A, 2B an 1B excluding SSAs) participation by organization type

(Percentages by number of institutions)



Small- and medium-sized enterprises

The importance of small- and medium-sized enterprises (SMEs) in stimulating new employment and innovation is well established, and the EU has a long-standing history of supporting and promoting them. To this end, SME participation has been integrated into project selection criteria.

SMEs have been important players in a number of mainstream aeronautics research initiatives. Thus, EU support does not go only to the 'big firms' and research institutions but also to smaller entities, including the numerous supply companies that provide components, subsystems, materials and other support within the technology supply chain.

FP6 has seen the introduction of Specific Support Action projects, such as AeroSME and SCRATCH, all initiatives dedicated to helping SMEs gain access to EU funding.

Abbreviations

BU	Bulgaria
CAN	Canada
CH	Switzerland
CHI	China
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FIN	Finland
FR	France
GR	Greece
HU	Hungary
IL	Israel
INT	International
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
RU	Russia
SE	Sweden
SL	Slovenia
SV	Slovakia
UK	United Kingdom

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AVITRACK	Tracking of Aircraft Surrounding, Categorised Vehicles and Individials for Apron's Activity Model Interpretation and Check	281
EMMA	European Airport Movement Management by A-SMGCS	284
OpTag	Improving Airport Efficiency, Security and Passenger Flow by Enhanced Passenger Monitoring	287
SPADE	Supporting Platform for Airport Decision-Making and Efficiency Analysis	290
B-VHF	Broadband VHF Aeronautical Communications System Based on MC-CDMA	293
IFATS	Innovative Future Air Transport System	296
AD44D	4D Virtual Airspace Management System	299
CAATS	Co-operative Approach to Air Traffic Services	302
C-ATM	Co-operative Air Traffic Management	305

FRESH

From Electric Cabling Plans to Simulation Help

Background

The industrialisation of an aircraft electrical harness relies almost entirely on manual methods. When changes are needed, wiring diagrams have to be checked manually and a new harness design process has to be started to integrate modifications. CAD (Computer Aided Design) exchanges are also very difficult in this field (due to hardware/software incompatibilities).To assess electric harness behaviour, simulation is very rarely used and existing symbol recognition methods are not satisfactory. FRESH proposes to design a specific and innovative recognition methodology to lead to an automatically generated system.

Project Objectives

- To convert electric wiring plans into Computer Aided Design wiring diagram language
- To translate CAD-generated wiring language into a universal language
- To adapt and improve available software to transfer wiring diagrams (in a universal language) into electrical harnesses
- To simulate electrical harnesses' physical behaviour, and benefit from simulation verification and optimisation capabilities.

And as a consequence:

- Reduce electrical harness development costs
- Produce an error-free intervention level
- Reduce harness modification, maintenance and overhauling costs.

Description of Work

FRESH comprises seven major Work Packages, without counting Work Package 0, which deals with management.

Work Package 1 deals with specification (selection of an example of a paper-wiring diagram as a basis of the research, ergonomic standards for targeted harness geographical plans and envelope boundaries of wiring and harness simulations).

Work Package 2 addresses wiring diagram recognition (methodology for recognition).

Work Package 3 deals with the conversion of paper or CAD wiring diagrams into a universal language (PIVOT).

Work Package 4 deals with harness numerical geometric plans (to adapt and improve freeware to transfer wiring diagrams into electrical harness).

Work Package 5 addresses wiring and harness simulation (by research on the algorithms and models to simulate the diagrams in a factual way).

Work Package 6 deals with the global automation system prototyping (a validated, fully automatic process for harness optimisation and smart maintenance).

Work Package 7 deals with dissemination and exploitation (to give general awareness on project results and to prepare the future industrial exploitation of project results).

Expected Results

The project will yield:

- An automated system to recognise paper electrical wiring diagrams and to convert them into reconstructed numerical wiring information.
- Dedicated modules to convert the reconstructed wiring information into a language understandable by classical tools to generate the harness.
- A system to design, through computing, the geometric plan of the harness.
- A smart electrical harness simulation system to check the electrical validity of the wiring diagrams and harness.

Acronym:	FRESH
Contract No:	AST4-CT-2005-516059
Instrument:	Specific Targeted Research Project
Total Cost:	€2 829 234
EU Contribution:	€1 854 135
Starting Date:	01/11/2004
Duration:	36 months
Website:	www.algotech.fr / www.aero-scratch.net
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Algo'Tech Informatique S.A.	FR
Centro de Estudios e Investigaciones Técnicas de Gipuzkoa (CEIT)	ES
Przedsiębiorstwo Techniczno-Handlowe "RECTOR" S.J.	PL
ZENON S.A. Robotics & Informatics	EL
tekever lda	PT
EADS Sogerma Drawings	FR
Euro Inter Toulouse	FR

IPAS

Installed Performance of Antennas on Aero Structures

Background

Currently, the implementation process for installing antennas on aircraft results in high costs and long timescales. There are errors in the coupling calculations used to obtain isolation between antennas on opposite sides of the fuselage, the design phase uses unverified computational modelling and there is a frequency gap in the computational software used. Scaled model measurements used to bridge this gap are expensive and time consuming. In-flight trials have severe limitations and the erroneous siting of antennas results in massive time and cost implications to the whole programme.

Project Objectives

The purpose of the programme is to improve computer-aided engineering design and evaluation capabilities (computational and measurement methods) for the installation of antennas on aircraft structures. This will be achieved by bridging the frequency gap in computational electromagnetic tools using refined hybrid and multi-domain methods and the development of fast solver methods for solving full-wave integral equation methods in the frequency domain.

The performance of antennas on non-metallic and hybrid materials such as GLARE will be investigated and more accurate coupling calculations based on measurements will be derived empirically. This will lead to an improved prediction of performance of antennas and interoperability, with consequent contributions to operational safety and on-board Internet access.

The feasibility of radiation pattern measurements on full-scale aircraft using an innovative airborne platform will be investigated. This is based on near-to-far-field transformations adapted to cope with irregular spatial sampling.

Description of Work

There are five technical Work Packages consisting of:

1. Characterisation of antenna data.
2. Improvements in computational tools, which will include hybridisation (of low and high-frequency codes), multidomain, Fast Multipole methods, asymptotic techniques, application to hybrid structures.
3. Verification of tools through measurements on flat panels, metal cylindrical tubes and scaled aircraft models, as well as verification of inverse methods for use in the validation of the ANTF (airborne near field facility). Additionally, empirical formulas will be derived for more accurate calculations of the coupling between antennas and a CAD cleaning tool developed for reducing the number of wire segments (and hence the CPU time) for MoM tools.
4. Full-scale measurements and modelling on real aircraft or full-scale mock-ups.
5. Production of codes of practice for the design and qualification phases of antenna siting on aerostructures.

Expected Achievements

Improvements in computational tools:

a) to bridge the frequency gap
b) for faster and multidomain methods
c) pertaining to non-metallic surfaces.

Code-to-code and code-to-measurement verification, leading to a reduction in the measurements required.

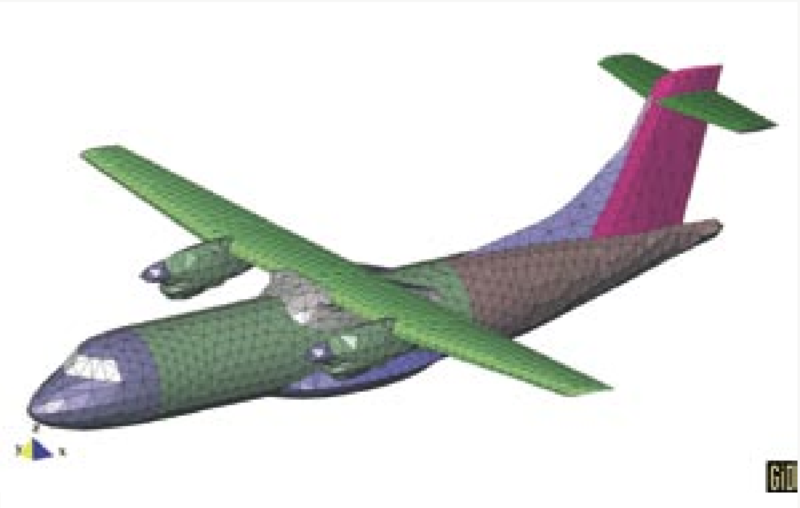
More accurate coupling calculations.

Mesh cleaning tools that can be used on standard desktops.

Networking of standard workstations to utilise idle CPU resources using grid technology.

Development of ANTF (airborne near field facility) concept.

Overall time and cost reduction and improved accuracy in antenna siting methods.



Acronym:	IPAS
Contract No.:	AST3-CT-2003-503611
Instrument:	Specific Targeted Research Project
Total Cost:	€6 104 242
EU Contribution:	€3 208 613
Starting Date:	01/11/2003
Duration:	36 months
Website:	www.aseris-emc2000.com/ipas
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Culham Electromagnetics & Lightning Ltd.	UK
Centre Internacional de Mètodes Numèrics en Enginyeria (CIMNE)	ES
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
EADS CCR	FR
Grid Systems	ES
Stichting Nationaal Lucht-en Ruimtevaart Laboratorium (NLR)	NL
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR

MUSCA

Multiscale Analysis of Large Aerostructures

Background

Structural testing of major aircraft components is a very expensive and time-consuming process that significantly adds to the overall cost of designing and certifying a new aircraft product. If testing can be reduced, based on validated and safe numerical analysis methods, this will provide the European aircraft industry with a significant business and technological advantage. Structural certification, based on a virtual testing process, appears a promising way to achieve the following global objectives in a medium term of five to seven years.

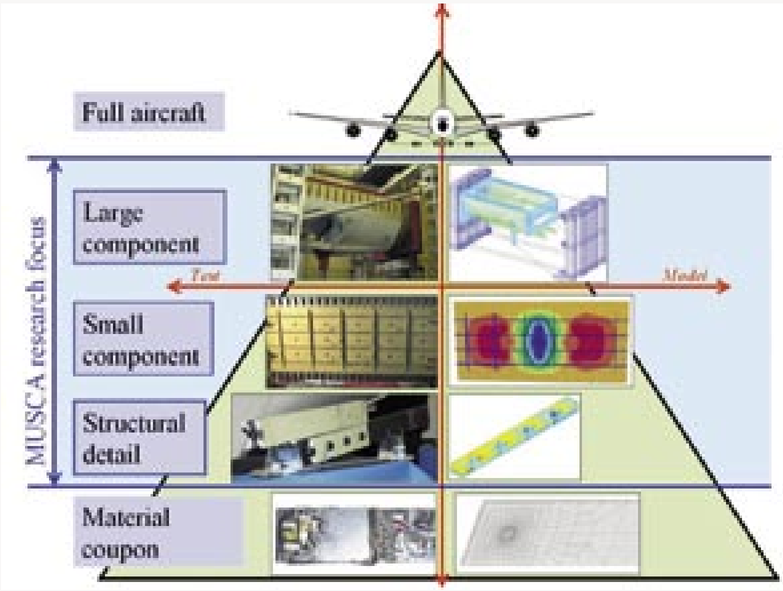
Project objectives

MUSCA's main objectives are to develop, test and validate new technologies for extending and improving large-component structural static analysis up to failure within the non linear (NL) domain. Propositions will be made to the Airworthiness Authorities for recommendations for a more cost effective structural justification process that makes greater use of advanced numerical simulation methods that still meet Airworthiness Authority and safety requirements.

Description of the work

Three key research areas will be addressed in order to reach MUSCA's strategic objectives:

Techniques for large-scale NL analysis: domain decomposition techniques, coupled with advanced parallel processing non linear solvers, error estimator for quality assessment of finite element models.



Multi-criteria failure analysis: critical review, selection and validation of the most efficient engineering procedures for multi-mode failure analysis of structural details.

Sensitivity and reliability techniques: assessment of input uncertainties (material properties, geometry and load scattering) on the structural performances using stochastic simulations (FORM and SORM Methods, advanced sampling techniques), sensitivity surface response methods (advanced regression).

Expected results

MUSCA will contribute to reducing the need for large component tests by extending the use of reliable, large-scale, NL calculation and reliability methods. MUSCA will enable improved preparation and exploitation of the remaining necessary physical testing through further validation of analysis methods, and the use of parametric and design sensitivity studies. Strong encouragement will be provided for further integrating numerical analysis methods into the design and certification process, and in the reduction of structural tests required for the certification of aircraft structures.

Acronym:	MUSCA	
Contract No.:	AST4-CT-2005-516115	
Instrument:	Specific Targeted Research Project	
Total Cost:	€5 316 687	
EU Contribution:	€3 236 440	
Starting Date:	01/09/2005	
Duration:	42 months	
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	Airbus Deutschland GmbH	DE
	Alenia Aeronautica S.p.A.	IT
	Saab AB	SE
	Dassault Aviation S.A.	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE

Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Swedish Defence Research Agency (FOI)	SE
Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
Centre de Recherche en Aéronautique A.S.B.L. (CENAERO)	BE
Ecole Normale Supérieure de Cachan	FR
Cranfield University	UK
Seconda Universitá degli Studi di Napoli	IT
University of Patras	EL

VIVACE

Value Improvement through a Virtual Aeronautical Collaborative Enterprise

Background

The VIVACE integrated R&T project, coordinated by Airbus, was set up in the framework of AECMA, addressing the Vision 2020 objectives. It was launched in January 2004 and is planned to run for four years with an overall budget of around 75 million euros. The budget will be shared between 63 companies and institutions that are co-operating in the project, which includes eight SMEs.

VIVACE has originated from past experiences and results gained in concurrent engineering such as in the ENHANCE Fourth Framework Programme project.

Project objectives

VIVACE intends to achieve a 5% cost reduction in aircraft development and a 5% reduction in the development phase of a new aircraft design, combined with a contribution to a 30% reduction in the lead time and 50% reduction in development costs respectively for a new or derivative gas turbine. The results will be achieved through a re-engineering and optimisation of the entire design process by modelling and simulating in an advanced, concurrent engineering environment. VIVACE will deliver a virtual product design and validation platform, based on a distributed concurrent engineering methodology supporting the virtual enterprise.

To achieve this overall objective, the work in VIVACE is organised around Use Cases, i.e. real industrial simulations of a part of the aircraft, the engine or of a development process, reflecting both the virtual product and the virtual extended enterprise. Each of them includes on the one hand requirements for early product simulation and on the other, requirements for distributed working methods.

Description of the work

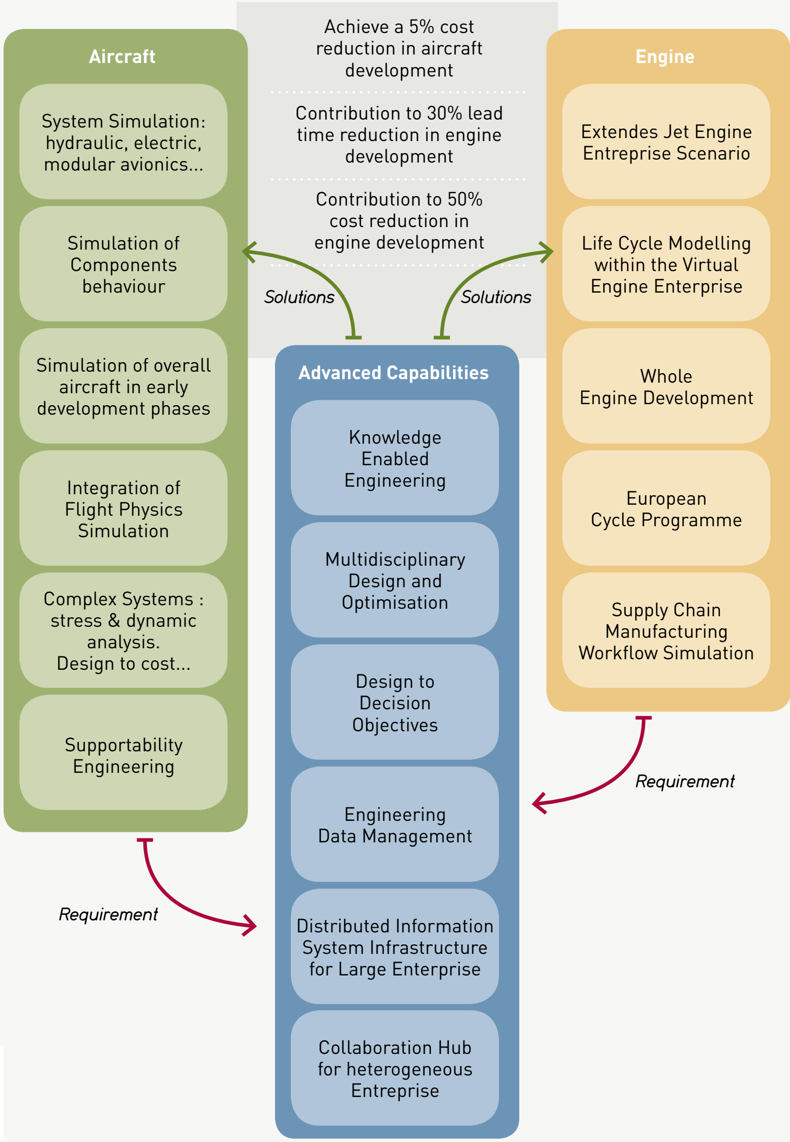
VIVACE has been designed around three technical sub-projects, two of them representing the aircraft and engine products, and the third one ensuring integration of component frameworks developed in sub-project 1 and 2 into a global framework - the VIVACE Collaborative Design Environment.

1.1. Virtual aircraft sub-project (leader: airbus france)

The Virtual Aircraft sub-project revolves around the main components that constitute an aircraft and has six integrated technical Work Packages: System Simulation, Components, Global Aircraft, Flight Physics Simulation, Complex Subsystems, and Supportability Engineering. It is designed to cover the aircraft product throughout the development life cycle (design, modelling, interfacing and testing).

1.2. Virtual engine sub-project (leader: rolls-royce plc)

The Virtual Engine sub-project consists of five integrated, technical Work Packages performing fundamental research to provide capabilities for a competitive European jet engine industry working across extended enterprises: Extended Jet Engine Enterprise Scenario, Life Cycle Modelling within the Virtual Engine Enterprise, Whole Engine Development, European Cycle Programme, Supply Chain Manufacturing Workflow Simulation. It focuses on the different engine modules of the aircraft propulsion



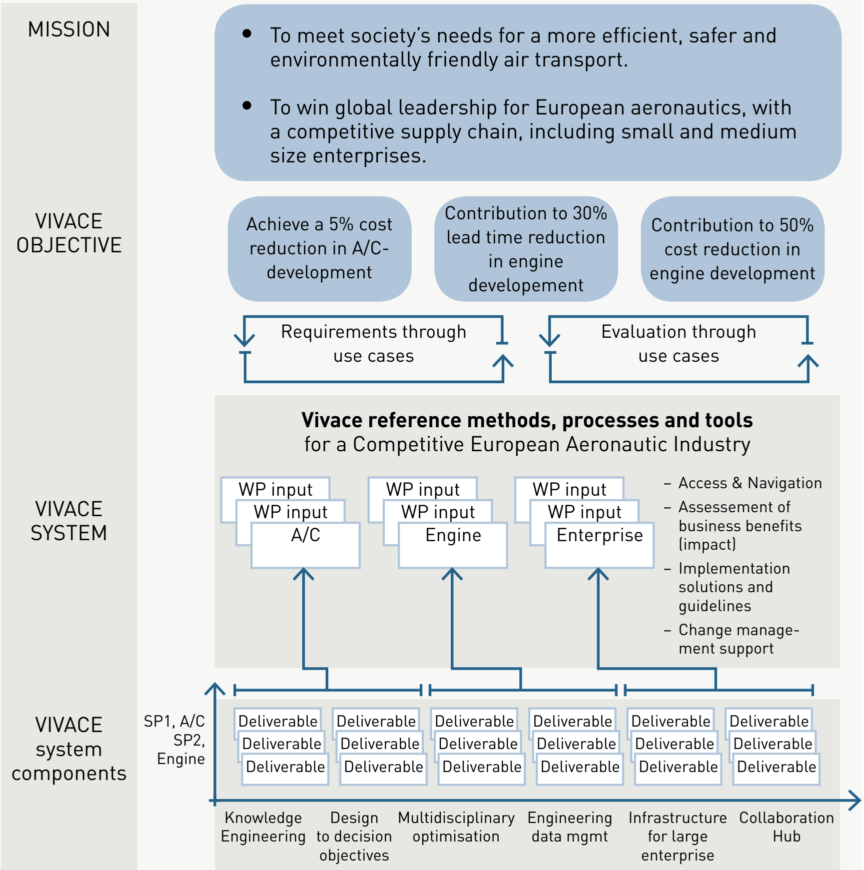
VIVACE Overall Structure

system and key areas of multi-disciplinary optimisation, knowledge management and collaborative enterprises.

1.3. Advanced capabilities sub-project (leader: crcf)

The Advanced Capabilities sub-project is a key integrating work area that develops common tools, methodologies and guidelines. It consists of a management Work Package and five integrated technical Work Packages that provide cohesion between the first two sub-projects through activities that are generic and common to both: Knowledge Enabled Engineering, Multi-Disciplinary Design and Optimisation, Design to Decision Objectives, Engineering Data Management, Distributed Information Systems Infrastructure for Large Enterprise, Collaboration Hub for Heterogeneous Enterprises.

The VIVACE system



Expected results

The main result of VIVACE will be an innovative Aeronautical Collaborative Design Environment and associated processes, models and methods. This environment, validated through concrete Use Cases, will help to design an aircraft and its engines, providing mode virtual products to the aeronautics supply chain operating in an extended enterprise, which has all the requested functionality and components for each phase of the product-engineering life cycle.

VIVACE will make its approach available to the aeronautics supply chain via existing networks, information dissemination, training and technology transfer actions.

Acronym:	VIVACE
Contract number:	AIP-CT-2003-502917
Instrument:	Integrated Project
Total cost:	€75 175 562
EU Contribution:	€43 300 000
Starting Date:	01/01/2004
Duration:	48 Months
Website:	www.vivaceproject.com
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	Airbus Deutschland GmbH	DE
	Airbus UK Ltd.	UK
	Alenia Aeronautica S.p.A.	IT
	BAE SYSTEMS (Operations) Ltd.	UK
	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (CERFACS)	FR
	Dassault Aviation S.A.	FR
	Dassault Systèmes S.A.	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	EADS Deutschland GmbH	DE
	EADS CCR	FR
	Centre de Recherche en Aéronautique A.S.B.L. (CENAERO)	FR
	Eurostep AB	SE
	Empresarios Agrupados S.A.	ES
	I-Sight Software S.A.R.L.	FR
	EPM Technology AS	NO

Eurocopter S.A.S.	FR
THALES Avionics Electrical Systems S.A.	FR
AVIO S.p.A	IT
Ajilon Engineering	FR
Hewlett-Packard Ltd.	UK
Universität Stuttgart	DE
Imperial College London	UK
Industria de Turbo Propulsores S.A.	ES
Hydro Control Steuerungstechnik GmbH	DE
Leuven Measurements and Systems International NV	BE
Luleå tekniska universitet (LTU)	SE
Messier-Dowty Ltd.	UK
MSC Software GmbH	DE
MTU Aero Engines GmbH	DE
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
National Technical University of Athens (NTUA)	EL
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Politecnico di Milano	IT
Politecnico di Torino	IT
The Queen's University of Belfast	UK
Rolls-Royce Deutschland Ltd. & Co. KG	DE
Rolls-Royce plc	UK
SAMTECH S.A.	BE
SAFRAN S.A.	FR
Techspace Aero S.A.	BE
THALES Avionics S.A	FR
Turbomeca S.A.	FR
University of Manchester Institute of Science & Technology (UMIST)	UK
Instituto de Desenvolvimento de Novas Technologias	PT
Cranfield University	UK
University of Nottingham	UK
Technische Universität Hamburg - Harburg (TUHH)	DE
University of Warwick	UK
Volvo Aero Corporation AB	SE
Xerox Italia S.p.A.	IT
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DESIDER

Detached Eddy Simulation for Industrial Aerodynamics

Background

The DESider project is motivated by the increasing demand of the European aerospace industries to improve analysis on turbulent, unsteady aerodynamic flows exhibiting massive separation. However, for complex, turbulent separated flows, RANS modelling has proved to be a poorly adapted approach. While LES has shown viable capabilities of resolving the flow structures, it is too costly to be used at present in aeronautical applications. To close the gap between RANS and LES, hybrid RANS-LES methods will be investigated, among which the so-called detached eddy simulation (DES) serves as a basis.

Project objectives

Based on the previously developed DES approach, the objectives are:

– To investigate and develop advanced modelling approaches for unsteady flow simulations as a compromise between URANS and LES, which are able to produce LES-comparable results for real aeronautical applications, yet with less costly computational resources compared to LES for an employment in industrial design environments.
– To demonstrate capabilities of hybrid RANS-LES approaches in solving industrially relevant applications with a focus on aerodynamic flows characterised by separation, wakes, vortex interaction and buffeting, i.e. all flows which are inherently unsteady.
– To investigate further that RANS-LES methods can be well applied to multidisciplinary topics as there are aero-acoustics (noise reduction) and aero-elastics (reduced A/C weight, unsteady loads, fatigue issues, improved A/C safety), improving this as a cost-effective design.
– To facilitate co-operation between the European industries, research establishments and universities and to foster co-operation between the different industries (as there are airframe, turbomachinery, helicopters and power generation, as well as turbo-engines and ground transportation) with the help of an 'observer group'.

Description of work

Work in the DESider project has been split into four Work Packages:

Work package 1: 'General management' is dedicated to the overall management of the project. Coordination work includes the set-up of a project website and web-server, http://cfd.me.umist.ac.uk/desider/ with a public part that is not password protected and which provides a more elaborate overview about the DESider project.

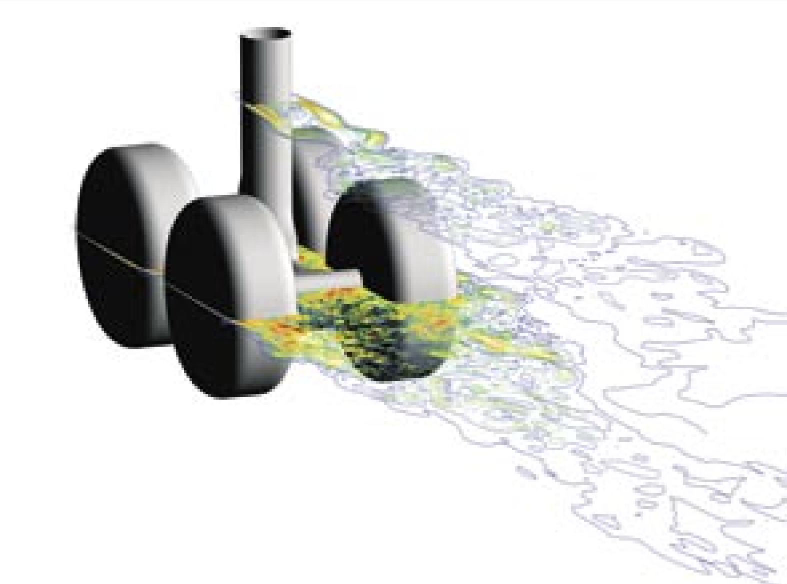
Work package 2: 'Experiments' is assembled around available experimental results and will be finished around the end of the second year of the project. Although test cases have been defined at the start they are going to be adjusted during the course of the project. Moreover, a new experiment will be carried out – a channel bump – that can be used for validating the hybrid RANS-LES methods that will be investigated. The set-up of these measurements was conducted by CFD computations in order to ensure that the experimental results will exhibit all flow-specific data needed for a proper validation of the highly sophisticated CFD methods. A specific post-processing will be carried out to extract typical structures from the measurement data.

Work package 3: 'Modelling' is a major task as it is needed to overcome current weaknesses in the different approaches, i.e. to improve both the predictive accuracy and code robustness to make sure that industrially relevant tools are available at the end of the project.

Work package 4: 'Applications' is split into two main tasks dealing with 'pure' aerodynamics and with multidisciplinary topics. In the aerodynamics task, work started with investigations on so-called 'underlying flow regime' cases, and is followed by 'real-world' application challenges. It will be finished with an assessment of URANS, LES and hybrid RANS-LES methods to demonstrate the successful outcome, as well as to show ways for both improvements and exploitation of the approaches used. Work on the aero-elasticity as well as the aero-acoustic tasks have been started at the beginning of the second year. Both applications are of much interest in order to demonstrate how methods and approaches can offer improved prediction capabilities for the structural behaviour (safety aspect) and noise propagation (environmental aspect).

Expected results

Advanced URANS and hybrid RANS-LES methodologies will be improved and their implementation in industrial approaches facilitated. Based on modification of turbulence scales in respect of flow unsteadiness, the theoretical approaches are going to be validated by detailed physical experiments. Moreover, as improved aerodynamics results will directly influence the accuracy of multidisciplinary industrial challenges, non-linear aero-elasticity and aero-acoustics problems will be treated, fostering the predictive capabilities in CFD and improving industrial design processes.



Acronym:	DESIDER
Contract No.:	AST3-CT-2003-502842
Instrument:	Specific Targeted Research Project
Total Costs:	€5 395 105
EU contribution:	€3 170 548
Starting date:	01/01/2004
Duration:	36 months
Website:	http://cfd.me.umist.ac.uk/desider/
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Partners:	EADS Deutschland GmbH - Military Aircraft	DE
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	AEA Technology GmbH	DE
	Chalmers Tekniska Högskola AB	SE
	Dassault Aviation S.A.	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Eurocopter Deutschland GmbH	DE
	Electricité de France	FR
	Swedish Defence Research Agency (FOI)	SE
	Imperial College London	UK
	Institut National Polytechnique de Toulouse	FR
	Centre National de la Recherche Scientifique (CNRS)	FR
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	New Technologies and Services	RU
	Numerical Mechanics Applications International S.A. (NUMECA)	BE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Technische Universität Berlin (TUB)	DE
	University of Manchester Institute of Science & Technology (UMIST)	UK

EUROLIFT II
European High Lift Programme II

Background

The European high-lift project EUROLIFT II started in January 2004 under the coordination of DLR as a STReP of the 6th EU Framework Programme. The project continues the successful work of its predecessor project, EUROLIFT I, under the leadership of Airbus-Deutschland. In view of the realisation of the demanding targets of the European Vision 2020, high-lift systems will deliver a substantial contribution in making the aircraft system more efficient and environmentally friendly. Corresponding potentials of the high-lift system are the aerodynamic efficiency increase with reduced maintenance effort, the development of more efficient theoretical and experimental methods for the industrial design process, and the reduction of noise emission during the take-off and landing phases by advanced high-lift concepts.

Project objectives

To achieve the aforementioned targets, advanced numerical and experimental methods are necessary, which have to be thoroughly validated with respect to the special requirements of high-lift flows and configurations. With the support of EUROLIFT II, these methods and the physical understanding of the dominant aerodynamic phenomena will mature to a level, which enables the solution of the envisaged overall requirements for high-lift systems.

The following direct objectives have been set:

- Validation of numerical methods for the exact prediction of the aerodynamics of a complete aircraft in high-lift configuration at flight Re-numbers up to maximum lift.
- Numerical and experimental analysis of the physical interaction due to the installation of a pylon mounted nacelle with the high-lift system. This covers a detailed understanding of vortex dominated aerodynamic effects as well as their impact on the aerodynamic performance. For this purpose, state-of-the-art RANS methods (Reynolds-averaged Navier-Stokes), and the wind tunnels ETW (European Transonic Wind Tunnel) and LSWT (Low Speed Wind Tunnel) of Airbus-Deutschland will be used.
- Specification of progressive high-lift systems, including numerical as well as experimental demonstration.

Description of the work

The EUROLIFT II project is sub-divided into three Work Packages. Work Package1 is devoted to Improved Validation based on EUROLIFT I data. The activities in Work Package1 address three major research areas: model deformation and installation effects, boundary layer and transition impact, and the study of flap setting and modification effects. All activities are purely numerical using advanced RANS solvers and existing numerical data of the EUROLIFT I project. Important open questions, which arose throughout EUROLIFT I, are addressed, such as the influence of the model-peniche , of the wind tunnel walls or of externally attached pressure tube bundles on high lift performance.

Work package 2 is devoted to research on 'Realistic High-Lift Configurations' and is also subdivided into three tasks: Realistic High Lift Configurations, Advanced High Lift Design and Novel Devices for Flow Control. The first task covers the wind tunnel tests of the stepwise modified KY3H configuration for low and high Re-No. conditions. Complexity stage I is based on the original EUROLIFT I configuration but equipped with a realistic span-wise gap at the fuselage/slat junction. This configuration requires the manufacture of a new inboard slat including the onglet and the slat horn. In configuration stage II, a pylon-mounted nacelle is added requiring the slat to have a cut out in the area of the pylon. The through-flow-nacelle with core-body and the pylon are designed and manufactured within the project. The most realistic but also most complex configuration represents stage III, which is based on stage II but includes strakes attached on the outer nacelle surface. All stages will be tested in the LSWT as well as the ETW wind tunnel. In parallel, extensive numerical computations, using state-of-the-art RANS methods, will be performed on all three stages and compared in detail to the experimental data. During the second task, an advanced flap for improved take-off performance will be designed using numerical optimisation methods. The final design will be manufactured and mounted on the KH3Y model. Then the aerodynamic potential of the new flap concept will be verified in a special devoted ETW test campaign. During the third task, novel devices for flow separation control aiming on a slat-less wing will be analysed, supported by corresponding wind tunnel test in the low speed facility of Airbus-UK.

The third Work Package is devoted to methods and tools. This Work Package is subdivided into three tasks: transition prediction, numerical methods, experimental transition and deformation measurements. The major focus is on the improvement of the numerical simulation tools with respect to transition prediction, physical modelling of turbulence, and efficient grid generation strategies. In parallel, an improvement of experimental methods for the application under cryogenic conditions is scheduled. These methods will be further developed, implemented and tested throughout the project's cryogenic test campaigns in Work Package 2

Expected results

The expected major achievement of EUROLIFT II will be a high quality validation database for full aircraft high lift configurations, covering a large Re-No . range from 1.3 million up to 20 million. These validation data are directly used to assess the potential and shortcomings of the numerical methods to increase the level of reliability of high lift simulation. As a step beyond pure analysis, an assessment of the potential of advanced optimised high-lift systems as a mean to meet future aircraft design challenges is carried out. Finally, the aerodynamic potential of new high-lift solutions on the leading and trailing edge are investigated and demonstrated.

Acronym:	EUROLIFT II
Contract No.:	AST3-CT-2004-502896
Instrument:	Specific Targeted Research Project
Total Costs:	€7 326 041
EU Contribution:	€3 738 542
Starting Date:	01/01/2004
Duration:	36 months
Website:	www.eurolift.net
Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Institute of Aerodynamics and Flow Technology Lilienthalplatz 7 DE-38108 Braunschweig

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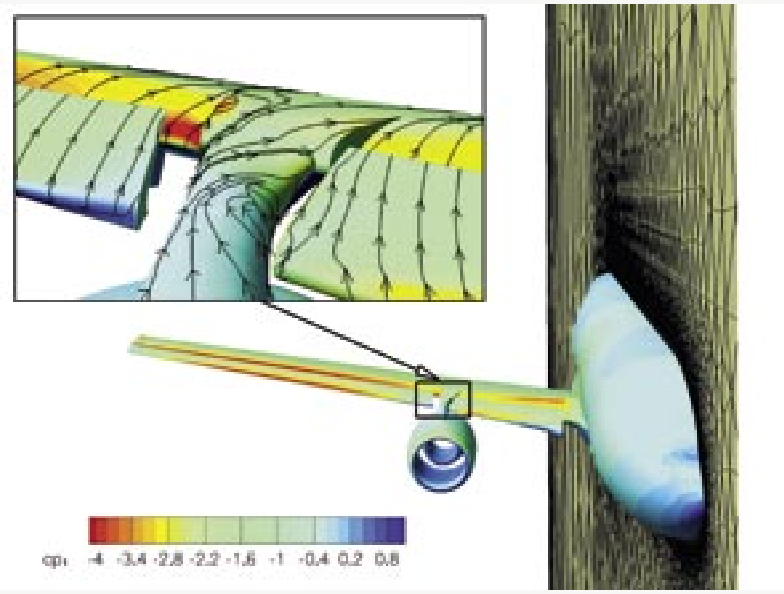
Alenia Aeronautica S.p.A.	IT
Icaros Computing Ltd.	EL
Dassault Aviation S.A.	FR
Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
European Transonic Windtunnel GmbH (ETW)	DE
IBK Ingenieurbüro Dr. Kretschmar	DE
Instituto Nacional de Técnica Aeroespacial (INTA)	ES
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Swedish Defence Research Agency (FOI)	SE



The state-of-the-art CFD methods used to predict flow over complete high-lift configurations are being validated against wind-tunnel data in the EUROLIFT II project.

EWA

European Windtunnel Association

Background

The initial dialogue between several European wind tunnel operators and research organisations regarding the concept of a Network of Excellence started in December 2002. This initiative was based on the view that building long-term, formal relationships between the research capacities of 14 member organisations from eight European countries, including three industrial organisations, three commercial wind tunnel operators, seven research organisations and one organisation for post-doctoral education, would provide direct technical and scientific synergy effects and improvements in competitiveness.

Project objectives

The goal of the European Windtunnel Association (EWA) is to form a Network of Excellence for aeronautical applications and related advanced measuring technologies with a management structure and a joint programme of activities. In a four-step progressive approach (Preparation, Harmonisation, Implementation, and Presentation of Integration) over a period of five years, it will integrate and strengthen European aeronautical research by building lasting relationships and interdependencies between the major European wind tunnels for aeronautical applications and developers of advanced measuring technologies for aeronautical applications. Thus, EWA will be able to provide research institutes and the aerospace industry with a comprehensive and harmonised set of better and extended services with full coverage of their possible needs. The network will also establish close links to leading European universities in the field of aeronautics in order to provide a fast transfer of new ideas. The benefits achieved by the co-operation activities will be disseminated to industrial end-users inside

ONERA S1 subsonic/ sonic wind-tunnel at Modane-Avrieux, France and outside of the association by means of an exchange of personnel, workshops and presentations of advanced measurement technologies performed in industrial wind tunnels.

Description of the work

The EWA project went live in April 2004. The first 18 months of the Joint Programme of Activities comprised the whole 12 months of Phase 1, Preparation of Integration, and the first six months of Phase 2, Harmonisation of Integration. The planned activities within this period primarily cover information exchanges about available resources, current interests, benchmarking of existing resources, identification of missing resources, building a road map to close any such gaps, and performing co-operative actions to improve mutual understanding and confidence-building measures. These activities are necessary and crucial for shaping EWA as a long lasting co-operation between partners coming from different cultures, who may have previously been competitors, within the narrow confines of the wind tunnel test market. EWA activities are currently organised in four Work Packages.

Work Package 1: Integrating activities is initially dedicated to the identification of test technique developments perceived by the EWA partners as a requirement to satisfy customers' future needs. Armed with this list of technology topics necessary to achieve our future vision, the partners will identify which particular topics are appropriate for them to co-operate on.

Work Package 2: Advanced wind tunnel testing is focused on the development and technical evaluation of measurement techniques and facilities. The most prominent intent is to develop and harmonise wind tunnel test techniques and standards in order to facilitate the execution of commercial and/or co-operative test programmes and the exchange of wind tunnel data.

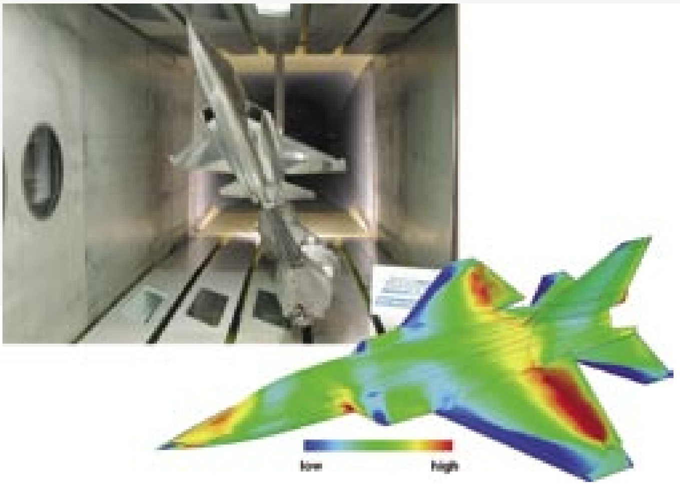
Work Package 3: Spreading of excellence activities covers one of the key objectives of EWA. The impact obtained from this co-operative network is turned into a common benefit for partners of the network and the European industry. Promotion of advanced measurement technologies through workshops and presentations of these techniques is accompanied by learning activities and training (including the exchange of personnel) of wind tunnel engineers.

Work Package 4: Management activities are, besides their obvious intent, dedicated to the promotion of gender equality within the network and human relationships among the partners across Europe.

Expected results

The expected outcome of EWA as a whole will be to integrate and strengthen European aeronautical research by building lasting relationships and inter-dependencies between the major European wind tunnel operators and developers of advanced measuring technologies. The partnership will be able to offer a harmonised and extended set of services to researchers and the global aerospace industry. EWA will also enable researchers to bring new experimental techniques into operation in industrial wind tunnels much faster than in the past.

Acronym:	EWA
Contract No.:	ANE3-CT-2004-502889
Instrument:	Network of Excellence
Total Cost:	€7 500 000
EU Contribution:	€7 500 000
Starting Date:	01/04/2004
Duration:	60 months



EADS MAKO model in test section of DNW-HST, pressure distribution measured by means of pressure sensitive paint (PSP) on the model surface.

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Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR) Institute of Aerodynamics and Flow Technology Bunsenstrasse 10 DE-37073 Göttingen
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Partners:	Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR)	DE
	German - Dutch Wind Tunnels (DNW)	NL
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
	Swedish Defence Research Agency (FOI)	SE
	Airbus Deutschland GmbH	DE
	Aircraft Research Association Ltd.	UK
	European Transonic Windtunnel GmbH (ETW)	DE
	BAE SYSTEMS (Operations) Ltd.	UK
	QinetiQ Ltd.	UK
	Vyzkumny a Zkusebni Letecky Ustav, A.S. (VZLU)	CZ
	Airbus UK Ltd.	UK
	Von Karman Institute for Fluid Dynamics (VKI)	BE

FLIRET
Flight Reynolds Number Testing

Background

FLIRET is closely related to aerodynamics and the wind tunnel testing of aircraft models, which has to guarantee a maximum of similarity to the flying aircraft. Only pressurised cryogenic wind tunnels can perform tests at Reynolds numbers, needed for a medium or large-sized aircraft. In contrast to conventional wind tunnels, they provide complete dynamic similarity to the flying aircraft. This type of testing still needs to be improved to get the full benefit of the new technology.

Project objectives

FLIRET's objective is to improve the accuracy of performance measurements at flight Reynolds numbers in cryogenic wind tunnels. The project focuses intentionally on model mounting techniques under cryogenic conditions. Model mounting devices have a significant influence on high Reynolds number performance measurements, which are currently compensated by empirical correction methods.

As far as the aircraft wing is concerned, testing at the flight Reynolds number provides the opportunity to reduce the weight of the wing as the profile thickness can be increased at the rear spar position, due to the thinner boundary layer and its high potential to act against adverse pressure gradients. The profiles can be optimised and tested in the Re-range occurring for the aircraft. There is no need to design wings for lower Reynolds numbers because of the constraints of conventional wind tunnels.

FLIRET will provide the missing links for industrial use of cryogenic testing. This includes contributions to special problems for complete and half-model testing, and the interactive use of advanced CFD tools for cryogenic testing.

Description of the work

Specialists from 16 partners in seven European countries are participating in FLIRET. The spectrum ranges from model design and manufacture to wind tunnel testing. The application of fluid dynamic design tools for optimisation purposes of supports and of advanced CFD is included in the work share to get the full benefit of all relevant disciplines.

The work is done in four Work Packages. Work Package 1 is the most important one. It is based on a support development strategy, which will provide improved supports for different test cases and model types.

Work Package 2 is devoted to high-speed buffet onset and model vibrations for complete models. Again, CFD specialists are strongly involved, to contribute to the testing process and to validate their tools for this class of test problems.

Special low-speed problems (related to take-off and landing of aircraft) are solved in Work Package 3 for half models. Clear recommendations concerning model roughness are expected in task 3.1 reducing costs and avoiding erroneous effects on flow similarity and accuracy of wind tunnel data. Task 3.2 will clarify special wall effects in cryogenic wind tunnels to ensure the consistency of half and complete model results under these special conditions.

Work Package 4 provides the final analysis and integration of all results.

Expected results

FLIRET will provide improved tools to increase the accuracy of cryogenic testing and to reduce test times. Both are necessary for an industrial use of cryogenic testing in the European aircraft industry.

Based on the expected results, a new wind tunnel strategy is under development allowing a high Reynolds number design of new aircraft. This strategy can make full use of the dynamically similar simulations of aircraft offered by cryogenic testing, leading to reduced wing weights and fuel consumption.

Acronym:	FLIRET
Contract No.:	AST4-516118
Instrument:	Specific Targeted Research Project
Total Cost:	€7 750 806
EU Contribution:	€4 249 999
Starting Date:	01/02/2005
Duration:	36 months
Website:	www.fliret.net
Coordinator:	Airbus Deutschland GbmH Department EGXG Hünefeldstraße 1-5 DE–28199 Bremen
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Partners:	Airbus Deutschland GmbH	DE
	Airbus France S.A.S.	FR
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	Airbus España S.L.	ES
	Aircraft Research Association Ltd.	UK
	Dassault Aviation S.A.	FR
	Deharde Maschinenbau H. Hoffman GmbH	DE
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	European Transonic Windtunnel GmbH (ETW)	DE
	IBK Ingenieurbüro Dr. Kretschmar	DE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Central Aerohydrodynamic Institute (TsAGI)	RU
	Helsinki University of Technology	FI
	Szewalski Institute of Fluid Flow Machinery	PL
	Technische Universität Berlin (TUB)	DE
	Universität Stuttgart	DE

ATENAA
Advanced Technologies for Networking in Avionic Applications

Background

Communications, navigation and surveillance services in the future avionics network will reflect significant advances in technology and capability and in the distribution of responsibilities for air traffic management.

Digital communications, which are the basis of the Personal Communication and In-Flight Entertainment in aeronautics, will be the cornerstone of the next generation's systems aimed at increasing transportation access and mobility, alleviating current airspace-capacity saturation. The implementation of these emerging technologies presents a considerable challenge, which the ATENAA project aims to meet.

Project objectives

The ATENAA project will investigate the possible use of Mobile Ad-Hoc Networking, Optical and Ka-band broadband communications as the emerging technologies within the context of a unified communication environment, which will be able to serve all future aviation needs, providing high quality services.

The objectives, which ATENAA has to accomplish, begin with the definition of the concept of a future networked avionic environment including moving platforms (aircraft and satellites), ground infrastructures, and the related users and communication systems.

Within such a framework, the identified emerging technologies are assessed against their applicability in the realisation of broadband communication systems for the avionic-networked environment. Testing and validation of these emerging HW and SW technologies are performed against a common set of service requirements.

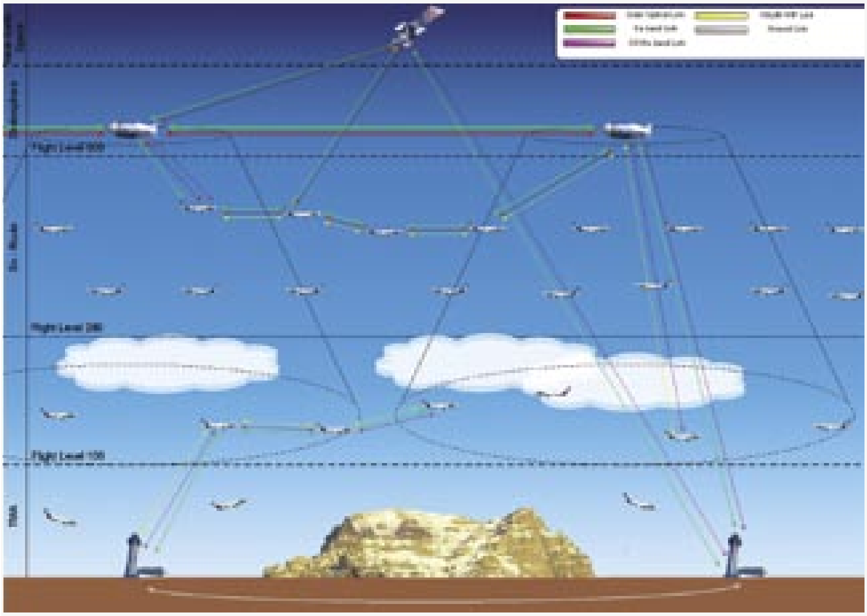
The final objective is to evaluate the overall performance and define a common baseline for the future demonstration and implementation of the avionic network.

Description of work

The technical work of the ATENAA project is subdivided into three main Work Packages.

The first Work Package investigates the possible use of Mobile Ad Hoc networking to present a complete communications package that will serve current and future avionics applications. Initially the Avionic Network concept will be introduced and an assessment of the present communication systems' performance will be made. After that, possible operational scenarios will be assessed and the related requirements for the network will be established. MANET routing protocols will then be investigated and simulated, to select those that best apply to an aeronautical environment. Finally, the work will focus on security aspects. Earlier analysis will be integrated with such considerations and the results will be evaluated through simulation.

Work Package 2 is dedicated to developing Ka-band transceiver technologies for avionic use. The work will initially focus on the RF system requirements definition. The system's overall architecture and the subsystems' specifications will be also defined based on the above analysis. The second point of interest is the development of Ka-band antennas. Two antennas will be considered: a receiving antenna (RX) in the range of 20 GHz and a transmitting antenna in the range of 30 GHz (TX). Additionally a Ka band phase shifter for the RX antenna will be studied, simulated, developed and tested. Lastly, the array antenna will be integrated and



tested. All the characteristics parameters will be measured in an antenna test range at the SATCOM Ka operational frequencies.

The third Work Package is aimed at investigating the technologies capable of increasing the network data throughput by implementing links at optical wavelengths. Initially an analysis will be performed and special attention will be paid to evaluating source safety, achievable data rates and operational range, as well as to the technologies needed to collimate and maintain the pointing of an optical beam when the transmitter and/or the receiver are installed onto a moving platform. Then the work will be further subdivided into outer links and inner links. In both cases, requirements will be defined and laboratory tests will be performed.

A final Work Package will see to the evaluation of project results and the dissemination and exploitation of project accomplishments.

Expected Results

The expected results of the ATENAA project are the assessment of MANET, Optical and Ka-Band broadband communications as key emerging technologies within the context of a future aeronautical network. Such a network will be able to provide high-quality services to the future avionics community. This will include enhanced flight safety, improvement of the crisis management capability, air traffic management capability, and the increase of the quality of all onboard available services (both ATM- and passenger-related ones).

Acronym:	ATENAA
Contract No.:	AST3-CT-2004-502843
Instrument:	Specific Targeted Research Project
Total Cost:	€5 416 907
EU Contribution:	€3 040 000
Starting Date:	01/07/2004
Duration:	33 months
Coordinator:	Selex Communications S.p.A. Via Pieragostini, 80 IT-16151 Genova
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Partners:		
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	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	EADS Deutschland GmbH	DE
	IN.SI.S. S.r.l.	IT
	Technological Educational Institute of Piraeus	EL
	THALES Avionics S.A.	FR
	THALES Communications S.A.	FR

GOAHEAD

Generation of Advanced Helicopter Experimental Aerodynamic Database for CFD Code Validation

Background

During the last ten years, considerable progress has been made in developing aerodynamic prediction capabilities for isolated helicopter components. This progress has been made possible due to the co-operations that were partly funded by European research projects. Today, cutting-edge CFD codes are available that are capable of predicting the viscous flow around main rotor-fuselage configurations. The greatest shortcoming for qualifying these methods as design tools in the industrial design process is the lack of detailed experimental validation data for complete helicopters.

Project objectives

The main objectives of GOAHEAD are:

- To enhance the aerodynamic prediction capabilities of Europe's helicopter industry with regard to complete helicopter configurations.
- To create an experimental database for validation of 3D unsteady Reynolds-averaged Navier-Stokes (URANS) CFD methods for unsteady viscous flows, including rotor dynamics for complete helicopter configurations (main rotor-fuselage-tail rotor), with emphasis on viscous phenomena like flow separation and transition from laminar to turbulent flow.
- To evaluate and validate Europe's most elaborate URANS solvers for the prediction of viscous flow around a complete helicopter, including fluid-structure coupling.
- To establish best practice guidelines for the numerical simulation of the viscous flow around helicopter configurations.

Description of the work

The project will have a four-year duration and will consist of five Work Packages. In Work Package 1 the detailed specifications of the test matrix for the wind tunnel experiment and the CFD evaluation and validation task will be elaborated. Work Package 2 is the CFD Work Package in which existing CFD codes will be applied to complete helicopter configurations in a blind-test and a post-test exercise. The wind tunnel experiments will be carried out in Work Package 3. The configuration to be investigated in the DNW LLF will be a Mach-scaled model of a modern transport helicopter consisting of the main rotor (R=2.1m), the fuselage (including all control surfaces) and the tail rotor. In order to keep the costs of the experimental campaign as low as possible, existing components will be reused. This will mean that the test configuration is not a scaled model for an existing helicopter, but this is not important because the aim is to produce data for CFD validation for any realistic configuration. The experimental set-up will be tailored to serve the needs of the aerodynamic validation for methods based on the unsteady Reynolds-averaged Navier-Stokes equations. Therefore, the 6m x 8m closed test section will be used. Velocity profiles and the turbulent kinetic energy will be measured at the inflow plane in order to define accurate boundary conditions in the CFD simulations. The measurement will comprise global forces of the main rotor and the fuselage, steady and unsteady pressures, transition positions, stream lines, position of flow separation, velocity fields in the wake, vortex trajectories and elastic deformations of the main and tail rotor blades. The data will be used in Work Package 4 for the validation of the CFD methods. Work Package 4 will establish best practice guidelines for the URANS simulation of complete helicopter configurations. Work Package 5 concerns itself with project management and will be responsible for the project exploitation.

Expected results

The main deliverables will be the deeply analysed experimental database for the complete helicopter, the report on the evaluation of the existing CFD URANS methods for complete helicopters, the report on the post-test computations and the best practice guidelines for the application of URANS methods. Since all European helicopter manufacturers apply CFD methods that have been and are being developed by one of the research centres or universities of the GOAHEAD consortium, the validation of these URANS methods will directly improve the industrial design processes.

GOAHEAD aims to validate URANS CFD codes for complete modern transport helicopter configurations.

Acronym:	GOAHEAD
Contract No.:	AST4-CT-2005-516074
Instrument:	Specific Targeted Research Project
Total Cost:	€4 975 808
EU Contribution:	€2 999 152
Starting Date:	1/7/2005
Duration:	48 months
Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Institute of Aerodynamic and Flow Technology Lilienthalplatz 7 DE-38108 Braunschweig
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Partners:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Eurocopter Deutschland GmbH	DE
	Eurocopter S.A.S.	FR
	Agusta S.p.A.	IT
	Westland Helicopters Ltd.	UK
	Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
	Foundation for Research and Technology Hellas	EL
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	University of Glasgow	UK
	Cranfield University	UK
	Politecnico di Milano	IT
	Universität Stuttgart	DE
	Aktiv Sensor GmbH	DE

AeroSME V

Support for European Aeronautical SMEs

Background

The project addresses the needs of aeronautical SMEs, which showed a low participation in previous framework programmes. At the instigation of the industry and with the active support of the EC, the AeroSME project was started to address this issue. AeroSME informs and supports SMEs interested in joining European technology projects. It is in the interest of SMEs, the Aeronautics industry and the EU to support smaller enterprises since their economic and strategic importance is well recognised.

Project objectives

1. To support aeronautical SMEs in advancing their technology base and their competitiveness through participation in European R&T projects to improve and maintain the competitiveness of the European aeronautical supply chain.
2. To promote SME participation in the Sixth Framework Programme (FP6) calls by providing the necessary supporting and information services.
3. To stimulate international co-operation by supporting and coordinating a reliable network between SMEs, industry, research institutes, universities and other entities.
4. To support the aerospace sector of the new Member States in joining the European aerospace community.
5. To stimulate the exchange of information and views among the various tiers of the supply chain by providing a communication platform, not only for SMEs but also for large enterprises and research organisations which usually have little direct access to the SME community. This will facilitate the dissemination and exploitation of the project results.

Description of the work

AeroSME is coordinated by ASD, the AeroSpace and Defence Industries Association of Europe (formerly AECMA), which represents the aerospace industry in Europe in all matters of common interest. Due to the privileged communication channels with large companies (represented in the Industrial Management Groups – IMG4), research establishments, universities, national and regional associations, AeroSME provides a proactive interface between SMEs and aeronautics-related bodies and represents a point of reference for SME issues. The coverage of all 32 countries associated with FP6 ensures a truly pan-European approach.

Through tailored services such as the helpdesk, the website, the SME database and the newsletters, the project improves the communication within the aerospace industry and provides SMEs with the information and individual consulting support that is required. Specific actions are undertaken in co-operation with IMG4 to facilitate the integration of SMEs in IPs and the set up of SME-led STREPs. Workshops for aeronautic SMEs are organised to raise awareness on European research issues and the industry's future needs, as well as facilitating contacts with large companies in the supply chain. A very pro-active approach is applied in the new Member States and Candidate Countries. Finally, AeroSME, based on an analysis of the SME role in FP6 projects, provides an overview of SME research needs and an evaluation of the FP6 instruments in order to propose recommendations and guidelines for future actions.

Expected results

Along with other EC supporting actions, AeroSME will aim to increase the percentage participation of SMEs in FP6. It will provide a 'one stop shop' for inquiries on both EU research and supply chain issues, also ensuring an impartial approach that is not linked to national or commercial interests. The relationship with IMG4 will facilitate the access of SMEs to information on research strategies and proposal preparation activities, which are not usually available to smaller companies.

Acronym:	AeroSME V
Contract No.:	ASA3-CT-2004-511045
Total Cost:	€827 620
EU Contribution:	€827 620
Starting Date:	01/10/2004
Duration:	24 months
Website:	www.aerosme.com
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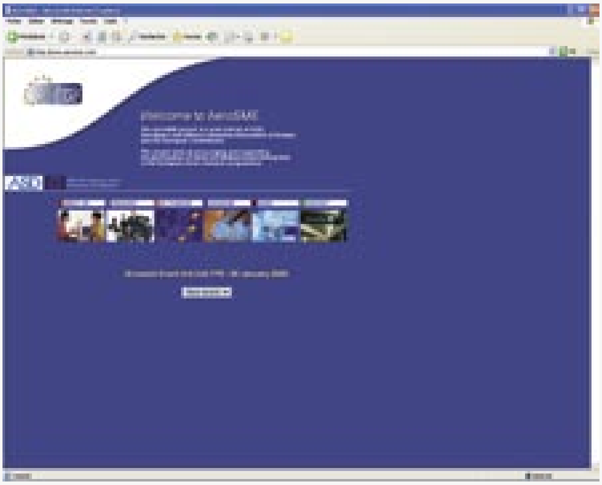

REMFI

Rear Fuselage and Empennage Flow Investigation

Background

It is well known that business needs are placing an ever-increasing demand on the aeronautics industry to develop and manufacture aircraft at lower costs, with improved flight capabilities and a reduced impact on the environment. Research efforts towards an improved understanding of the flow physics around fuselage/tail combinations remain limited. However, a successful design approach towards the development of modern transport aircraft has to include the empennage as well. Performance guarantees for future aircraft have to be granted earlier and with higher accuracy compared with former developments.

Project objectives

In order to cope with the current aeronautics industrial needs, which are different from what was relevant in the past, a new integrative approach is proposed, closing the gap between the current classical and the possible future unconventional empennage design. This can be achieved by bringing the current tail design to its utmost level of optimised performance with highly efficient empennage control surfaces. Thus, the improvements to be achieved by REMFI focus on three main aspects: the enhanced understanding of the tail flow physics, improved computational predictions for fuselage/tail design and analysis, and improved experimental capabilities and measuring techniques for tail flows. These aim at providing the means to:

– increase the empennage aerodynamic efficiency and reduce loads
– improve empennage performance and weight for optimised gap effects, including Reynolds number effects
– investigate sting mounting effects on empennage wind tunnel measurements;
– enhance the current scaling methodologies to flight conditions
– reduce fuel burn (a positive effect on energy saving and reduction of emissions to the environment)
– provide novel design concepts for integrated fuselage/empennage designs with regard to significant interaction between rear fuselage and belly fairing
– shorten the design cycle by reducing the cost of the aerodynamic design of tail and fuselage; reduce the maintenance costs.

Description of work

The REMFI project is structured in four complementary technical Work Packages plus one project management Work Package: Project Management and Coordination; Empennage improved control surfaces efficiency; Sting mounting arrangement interference investigation; Experimental verification study; Innovative integrated fuselage and empennage designs. These Work Packages represent a major path each with either numerical or experimental test technology, or both activities. They contain a number of tasks and sub-tasks that reflect the logical phases of the project contents. Combined, the technical Work Packages contain all the theoretical and experimental research activities necessary for the successful qualification of state-of-the-art simulation tools to achieve the anticipated design capability, in support of improved rear-end configurations: precise numerical simulation of tail-specific flow phenomena for full-scale aircraft on the basis of the CFD tools currently used for the aerodynamic design of wings at their design conditions; experimental verification study by means of high-resolution test data, including data at full-scale flight conditions; tail-orientated improvement

of wind tunnel measurement and testing techniques; integrated fuselage and empennage designs.

Expected Results

The following major achievements are expected:

- fully optimised empennage design with highly efficient control surfaces with respect to elevator / rudder fuselage gaps and transition effects on empennage performance (efficiency and hinge moments)
- improved live-rear-end measuring techniques, including comprehensive understanding of split gap and twin-sting mount arrangement effects on the empennage measurement accuracy
- comprehensive set of tail-specific data for advanced aircraft type configurations containing detailed flow field information up to full-scale Reynolds numbers
- improved knowledge on scale effects up to true flight Reynolds numbers
- new and innovative designs for integrated fuselage and empennage including belly fairing.

Acronym:	REMFI
Contract No.:	AST3-CT-2004-502895
Instrument:	Specific Targeted Research Project
Total Cost:	€6 366 204
EU Contribution:	€3 514 683
Starting Date:	01/03/2004
Duration:	36 months
Website:	www.cimne.com/remfi

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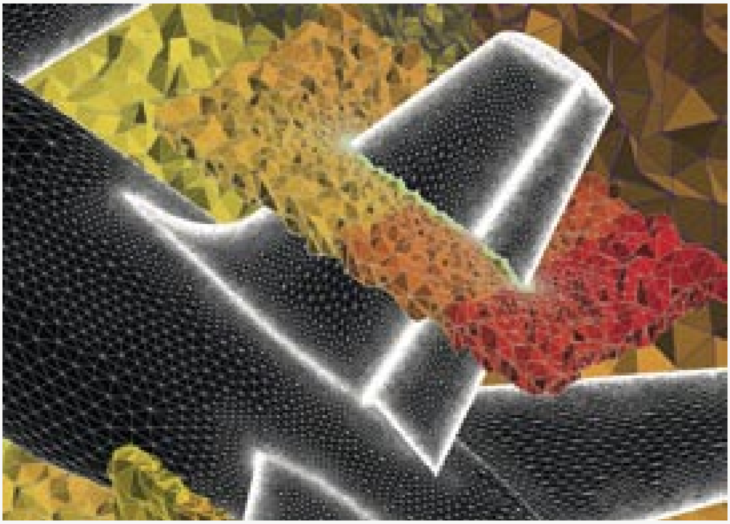
	Airbus Deutschland GmbH	DE
	Airbus France S.A.S.	FR
	Dassault Aviation S.A.	FR
	Aircraft Research Association Ltd.	UK
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Swedish Defence Research Agency (FOI)	SE
	Instituto Nacional de Técnica Aeroespacial (INTA)	ES
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Centre Internacional de Mètodes Numèrics en Enginyeria	ES
	European Transonic Windtunnel GmbH (ETW)	DE
	Universidad Politécnica de Madrid	ES
	Kungliga Tekniska Högskolan (KTH)	SE
	Technische Universität Berlin (TUB)	DE
	Technische Universität Braunschweig	DE
	Rheinisch-Westfälische Technische Hochschule Aachen	DE



SUPERTRAC

Supersonic Transition Control

Background

Reducing the extent of turbulent flow by delaying laminar-turbulent transition on an aircraft wing is of considerable practical interest because it reduces the friction drag. In supersonic flow, it also contributes towards satisfying the strict requirements on emission and noise. In this project, fundamental, numerical and experimental investigations will be carried out for evaluating the capabilities of several control techniques on supersonic civil aircraft wings.

Project objectives

The general objectives of the SUPERTRAC project are to explore the possibilities of skin friction drag reduction on supersonic aircraft wings by delaying laminar-turbulent transition. The following laminar flow techniques will be tested:

- micron-sized roughness elements;
- suction at the wall (Laminar Flow Control)
- pressure gradient optimisation (Natural Laminar Flow).

In addition, the problem of preventing leading edge contamination will be addressed.

To support these investigations, three models will be used: two 'physical' models with a simple geometry, which will be tested in supersonic wind tunnels, and one 'numerical' (and more realistic) model, which will be used for computations only.

Description of the work

The project is divided into six Work Packages.

In Work Package 1 (Specifications), the industrial partners will provide a quantitative definition of the objectives, as well as the preliminary definition of a fully 3D wing, which will be used as a reference shape ('numerical' model).

The objective of Work Package 2 is to define a simple model (swept wing of constant chord) equipped with micron-sized roughness elements and anti-contamination devices. This model will be manufactured and tested in the S2 wind tunnel of the Modane-Avrieux ONERA centre.

Work Package 3 will run in parallel with Work Package 2. Another swept wing of constant chord, equipped with a suction panel in the leading edge region, will be designed, manufactured and tested in the RWG wind tunnel of DLR Göttingen.

Work Package 4 will use the 'numerical' model defined in Work Package 1. The objectives are i) to numerically investigate the concept of Natural Laminar Flow Control by shape optimisation, ii) to analyse the compatibility of the different control techniques, in particular those of Work Packages 2 and 3. This will result in the definition of the best compromise for skin friction drag reduction.

The results of Work Packages 2 to 4 will be summarised in Work Package 5 by the industrial partners, who will provide a quantification of the benefits and recommendations for practical applicability to future supersonic aircraft wings.

Work Package 6 is devoted to the management and the exploitation of the project.

Expected results

At the end of the project, much original information will be available:

- Experimental data based on the effects of suction, micron-sized roughness elements and anti-contamination devices

- Advanced numerical tools for the design of these control systems
- Statements concerning the efficiency of the various control techniques investigated
- Definition of the best 3D wing shape and estimation of the benefits.

Acronym:	SUPERTRAC
Contract No.:	AST4-CT-2005-516100
Instrument:	Specific Targeted Research Project
Total Cost:	€2 930 000
EU contribution:	€1 600 000
Starting Date:	01/01/2005
Duration:	36 months
Website:	wwwe.onecert.fr/projets/supertrac
Coordinator:	Office National d'Etudes et de Recherches Aérospatiales (ONERA) 29, avenue de la Division Leclerc FR-92322, Châtillon Cedex
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Partners:

Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Airbus UK Ltd.	UK
Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
Dassault Aviation S.A.	FR
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
Swedish Defence Research Agency (FOI)	SE
IBK Ingenieurbüro Dr. Kretzschmar	DE
Instituto Superior Técnico (IST)	PT
Kungliga Tekniska Högskolan (KTH)	SE

TELFONA

Testing for Laminar Flow on New Aircraft

Background

The 2020 ACARE targets present a challenge to aircraft manufacturers to reduce CO2 emissions through engine efficiency and aircraft design improvements. A 'pro-green' aircraft configuration has been proposed that has a significantly higher aspect ratio wing and lower wing sweep than today's standard designs. This reduction in sweep opens the possibility to design a wing for natural laminar flow (NLF). Such a wing could enable a 20% wing drag reduction in comparison to today's designs.

Project objectives

The major objective of TELFONA is the development of the capability to predict the in-flight performance of an NLF aircraft using wind tunnel tests and CFD calculations.

A number of supporting objectives have been defined:

- Transition prediction tool calibration for NLF aircraft testing in ETW using a specially designed wind tunnel model.
- Improvement of transition receptivity models using wind tunnel test data from ETW and small-scale facilities to understand better how surface quality and atmospheric conditions influence transition mechanisms.
- Development of methods for predicting the in-flight performance of an NLF aircraft, including understanding whether conventional scaling approaches using low Reynolds number wind tunnels can be used.
- Validation of the developed methods through the design, manufacture and test of an NLF wing designed for high performance.
- Development of technology for wind tunnel testing of hybrid laminar flow control wings.

Description of the work

A pathfinder wing will be designed to determine the N-factor levels within ETW with the emphasis on cross-flow and TS instabilities. The design will then be made into a wind tunnel model with pressure tappings and sensors for transition detection. The ETW test will include measurement of boundary layer data and oncoming flow quality. The PETW pilot facility will be used to prove the proposed measuring techniques before the wind tunnel model is made. The pathfinder model will be tested in a wide range of conditions to build a large database of results and these test results will be used to determine the N-factor characteristics of ETW. The transition calculations using test data will be compared to results from the design phase. Test data will also be used to develop the means of linking the flow characteristics in the wind tunnel with the measured transition behaviour. This activity will be supported by university wind tunnel tests. Pathfinder test data will be used to determine performance-scaling methods for NLF aircraft and the design of the performance wing will use the new calibration data. The performance wing will be used to demonstrate NLF drag reductions and will also be tested in ETW. The range of test conditions of this test will be reduced compared to the first test and will be representative of flight conditions. The results from the performance test will be analysed to validate the N-factor calibration method and the performance scaling methods, and hence provide a validated in-flight performance prediction for a large NLF aircraft. In addition, a small activity will be undertaken to identify a means of testing a future HLFC suction system.

Expected results

The successful completion of the project will result in two wind tunnel model tests and improved transition prediction methods. The first 'pathfinder' model will be tested in ETW with the results being used to calibrate transition prediction methods, and to provide insight into the receptivity problem. The second 'performance' model will be designed using the calibrated methods and will be used to demonstrate the potential of a large NLF aircraft.

Acronym:	TELFONA	
Contract No.:	AST4-CT-2005-516109	
Instrument:	Specific Targeted Research Project	
Total Cost:	€5 173 922	
EU contribution:	€3 025 104	
Starting Date:	01/05/2005	
Duration:	42 months	
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Partners:	Airbus UK Ltd.	UK
	Airbus Deutschland GmbH	DE
	Airbus España S.L.	ES
	Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	European Transonic Windtunnel GmbH (ETW)	DE
	Swedish Defence Research Agency (FOI)	SE
	Imperial College London	UK
	Instituto Superior Técnico (IST)	PT
	Kungliga Tekniska Högskolan (KTH)	SE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Piaggio Aero Industries S.p.A.	IT
	Technische Universität Berlin (TUB)	DE
	Vyzkumny a Zkusebni Letecky Ustav, A.S. (VZLU)	CZ
	Alma Consulting Group S.A.S.	FR

UFAST

Unsteady Effects of Shock Wave Induced Separation

Background

Too little effort has so far been devoted to the accurate prediction and control of phenomena associated with unsteady shock wave boundary layer interaction problems. Even where advanced CFD techniques have been applied, these deal mainly with steady flow problems and modelling is often a simple extrapolation from incompressible/subsonic domains to transonic/supersonic flow regimes. It is obvious that there is a lack of understanding of flow physics with respect to unsteady Shock Wave - Boundary Layer Interaction (SWBLI) phenomena, which clearly underlines the need for specific and appropriate modelling of the flow of interest and, more importantly, for control technologies capable of reducing any physical risks for aircraft as much as possible.

Project Objectives

The first objective of the UFAST project is to provide a comprehensive experimental database, which will document both the low-frequency events and the properties of the large-scale coherent structures associated with SWBLI. Currently very little experimental information is available, in particular for industrially relevant flow cases. The flow configurations to be measured with and without control will correspond to generic geometries that can provide the understanding necessary for geometries that are more complex. The basic test cases include airfoils/wings, nozzles, curved ducts/inlets and oblique shock reflection i.e. all important flow cases governed by normal and oblique shocks. This wide choice of basic configurations is necessary to determine the general features of unsteady interactions.Devices will be used to control large eddies, and include perforated walls, stream-wise vortex generators, synthetic jets, and magneto- and electro-hydrodynamic actuators (EHD/MHD).

The second objective deals with application of the theoretical methods, RANS/URANS hybrid RANS-LES and LES approaches, for both improving the understanding of SWBLI as well as the modelling of flow physics. This investigation also includes advanced numerics, as well as advanced modelling strategies and investigations on the 'range of applicability' for the different methods involved. The outcome of UFAST in this respect will be best-practice guidelines of SWBLI problems.

Description of the work

The UFAST project is dedicated to the creation of a pertinent and novel database, and is organised around three typical SWBLI physical phenomena corresponding to different geometries and flow configurations: transonic interactions (external flows), interaction in channels (internal flows) and oblique shock reflection. All these flow cases are studied with the application of the same tools, capable of providing the best understanding of SWBLI physics. Experiments will concern plain interaction and the effect of flow control methods. All measured cases will form the basis for theoretical work using the RANS/URANS approaches to turbulence modelling and finally the LES and Hybrid RANS-LES techniques. The main goals of the project are to generate a database of unsteady separated SWBLI, provide information on the effectiveness of control methods, and to assess the ability of URANS and LES to predict these flows.

The management of the project and its structure takes account of these objectives in order to be highly effective so the Work Package structure is tool orientated:

Work Package 2: basic experiments

Work Package 3: experiments with flow control

Work Package 4: CFD – RANS/URANS

Work Package 5: CFD Hybrid/LES.

Each Work Package is also subdivided into tasks, reflecting the three physical configurations of shock interaction investigated in UFAST. These are, in particular, interaction on a profile, normal shock interaction in a channel and shock reflection.

The management of the UFAST project is taking particular account of the project's complexity. A special effort is directed towards the harmonisation of progress across Work Packages in relation to the investigated flow phenomena. Special emphasis is placed on enabling a significant interchange of results and ideas between Work Packages. Each Work Package will make a link between the experiments and CFD, inspiring the necessary circulation of scientific information. This close interaction will allow CFD to contribute directly to the preparation of experiments, the selection of measurement methods and the standardisation of results presentation. Measurements will be directed by predictive CFD contributions, a new feature of cooperation offered in UFAST.

Expected results

The major outcome of the UFAST project will be the improvement in physical understanding of all phenomena governing shock wave/boundary layer interaction. New knowledge will be generated concerning unsteady interaction phenomena, such as coupling between low frequency vortex shedding and shock movement or turbulence amplification/decay at the shock wave. A number of important fundamental questions will be addressed by the project and the answers will be of general applicability. The results will be presented in the form of a databank. The experimental databank will continue to serve the development of new numerical method as well as forming a reference for new measurements, even after UFAST has terminated. The databank comprising CFD results will represent the present state of CFD development, which will be a useful example for the demonstration of future progress.

Acronym:	UFAST
Proposal No.:	AST4-CT-2005-012226
Total Cost:	€3 803 803
EU Contribution:	€2 400 000
Starting Date:	01/12/2005
Duration:	36 months
Coordinator:	The Szewalski Institute of Fluid Flow Machinery Polish Academy of Sciences Fiszera 14 PL-08 952 Gdansk

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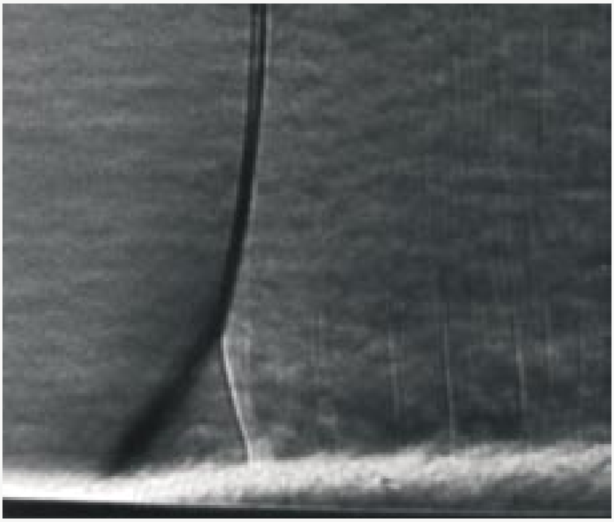
Partners:	Institute of Fluid Flow Machinery (IFFM)	PL
	Centre National de la Recherche Scientifique (CNRS)	FR
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	University of Cambridge	UK
	The Queen's University of Belfast	UK
	Institute of Theoretical and Applied Mechanics (ITAM)	RU
	Technische Universiteit Delft	NL
	Institutul National de Cercetari Aerospatiale ''Elie Crafoli''	RO
	University of Southampton	UK
	Università degli Studi di Roma 'La Sapienza'	IT
	University of Glasgow	UK
	Numerical Mechanics Applications International S.A. (NUMECA)	BE
	Institut National Polytechnique de Toulouse	FR
	Foundation for Research and Technology Hellas	EL
	Ecole Centrale de Lyon	FR
	EADS Deutschland GmbH - Military Aircraft	DE
	Instytut Lotnictwa	PL



Schlieren pictures of shock wave

Boundary layer interaction

WALLTURB

A European Synergy for the Assessment of Wall Turbulence

Background

Europe is seeking to reduce aircraft development and operating costs. To reach these objectives, the aeronautical industry will need improved CFD models based on a deeper understanding of the physics, acquired using the most advanced experimental and modelling methods.

The WALLTURB project intends to make significant progress in the understanding and modelling of near-wall turbulence in boundary layers. It is the inner part of the boundary layer nearest the wall that is crucial in determining the skin friction drag and it is in this region that the present turbulence models are least reliable, most notably when the flow is close to separation or separated. A better understanding and modelling of this region is crucial.

Project objectives

The objective of this project will be achieved by:

- generating and analysing new data on near-wall turbulence
- extracting physical understanding from the data
- putting more physics into the near-wall RANS models
- developing better LES models near the wall
- investigating alternative models based on Low Order Dynamical Systems (LODS).

Description of the work

The work programme is divided into six Work Packages.

Work Package 2 is focused on the experiments and DNS performed during the project.

Work Package 3 is the kernel of the project as it is responsible for the management and processing of the eight different databases that will be provided by the partners for common use.

Work Package 4 is concerned mostly with the classical and industrial RANS approach and has the aim of improving the physical content of the models, especially for Adverse Pressure Gradient flows.

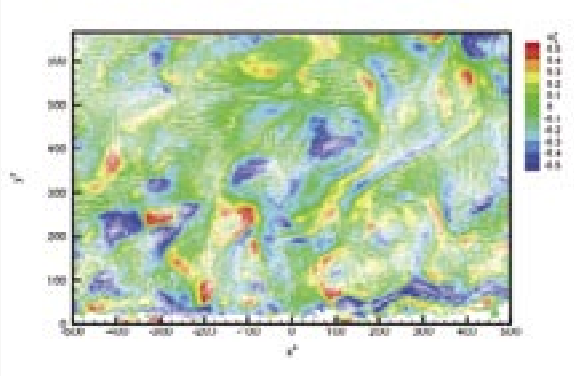
Work Package 5 is devoted to the improvement of LES modelling near the wall, and especially the investigation of new models for this region.

Work Package 6 will investigate the possibilities of the fairly recent Low Order Dynamical Systems approach, and of its coupling with LES in the near-wall region.

Expected results

The main expected outputs of the programme are:

- A detailed database of results on the flow structure of turbulent boundary layers in both zero and adverse pressure gradient, suitable for both physical analysis and turbulence model validation.
- Improved RANS model capable of coping properly with the near-wall region of the turbulent boundary layer.
- Improved LES models with a better modelling of the near-wall region of the turbulent boundary layer.
- LODS models, representative of the very near-wall region of the turbulent boundary layer, which can be coupled, as boundary conditions, to the LES models.



Acronym:	WALLTURB
Contract No.:	AST4-CT-2005-516008
Instrument:	Specific Targeted Research Project
Total Cost:	€2 925 500
EU Contribution:	€1 800 000
Starting Date:	01/04/2005
Duration:	48 months
Website:	http://wallturb.univ-lille1.fr
Coordinator:	LML UMR CNRS 8107 Cité Scientifique, Bv Paul Langevin FR-59655 Villeneuve d'Ascq
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Partners:

Centre National de la Recherche Scientifique (CNRS)	FR
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Chalmers Tekniska Högskola AB	SE
Association pour la Recherche et le Développement des Méthodes et Processus Industriels	FR
University of Cyprus	CY
Università degli Studi di Roma 'La Sapienza'	IT
University of Surrey	UK
Universidad Politécnica de Madrid	ES
Technische Universität München (TUM)	DE
Częstochowa University of Technology	PL
Norwegian Defence Research Establishment (FFI)	NO
Airbus UK Ltd.	UK
Dassault Aviation S.A.	FR

ADELINE

Advanced Air-Data Equipment for Airliners

Background

The overall objective of ADELINE is to identify technologies enabling the further development of innovative, fully European air data systems for implementation on new transport aircraft around 2007.

Project objectives

The objectives of ADELINE are to increase aircraft safety by reducing the possibility of air data system failure, to develop simpler, more reliable and safer air data equipment, to decrease direct possession costs of present air data systems, and to make a step change in air data system reliability, fault detection and susceptibility to blockage by foreign objects. The reliability will be increased by the use of innovative measuring systems with a better resistance to external hazards, new materials and coatings for the probes to increase abrasive resistance, and to increase lifetime and maintain constant lifetime performance, new de- and anti-icing technologies using new innovative heating elements and a new auto test for the pressure sensor to detect erroneous information. The cost of the system will be lowered due to the reduction of the number of parts per probe, integration of the sensors in the probes with innovative packaging, which will allow the elimination of all pneumatic tubing and connections. The use of self-regulated PTC heaters remaining at a constant temperature will allow the elimination of the expensive Probe Heater Computer.

Description of the work

The requirements for new air data systems will be defined in terms of safety, reliability, fault tolerance, operational performance, installation and maintenance. The typical architectures used by the main manufacturers in this field will be analysed in terms of these criteria.

New measurement principles for aerodynamic probes will be researched in order to reduce their sensitivity to the external environment. Candidate materials, coatings and manufacturing technologies, which could be used to improve corrosion resistance and decrease cost, will be identified. Potential technologies for probe anti –icing and de-icing will then be identified. Innovative ways to integrate additional functionality into the housing of the MEMS pressure sensor will then be researched.

Laboratory mock-ups will be tested in a dry wind tunnel in order to validate their aerodynamic shape and the new measurement principles. Existing MEMS pressure sensors will be modified to include the self-test principle to evaluate the sensitivity and the repeatability of the auto test. Other mock-ups will be tested under corrosive conditions to evaluate the most suitable cast material, casting technology, coating material and coating technology.

Two functional mocks-up will be tested in dry wind tunnel and icing conditions to evaluate their compliance with the requirements of the equipment specifications. The tests will be divided in two categories: metrological tests and environmental tests. Accelerated lifetime tests will be performed and the mock-ups will be also tested in flight conditions.

Expected results

ADELINE will help provide a better knowledge of existing air data architectures and their shortcomings in order to propose better-adapted, more reliable and cheaper air data equipment

Probe corrosion and icing protection will be aspects that will be addressed as part of ADELINE, a project which aims to develop new sensors that are immune to external hazards, based on new measurement principles.

to aircraft manufacturers in the future. Thanks to the consortium skills, ADELINE will also permit the identification of emerging measurement techniques, materials, ceramics, coatings and packaging techniques, which will allow improved resistance to wear and corrosion of probes, ensure a more efficient way to de-ice probes with no overheating risk and decrease the overall cost of air data architectures by reducing the number of units.

Acronym:	ADELINE	
Contract No.:	AST4-CT-2005-516165	
Instrument:	Specific Targeted research Project	
Total Cost:	€3 315 234	
EU Contribution:	€2 129 617	
Starting Date:	15/01/2005	
Duration:	36 months	
Website:	www.adeline-aero.org	
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Partners:	THALES Avionics S.A.	FR
	ATCT Industries Ltd.	IL
	Vyzkumny a Zkusebni Letecky Ustav, A.S. (VZLU)	CZ
	Castings Technology International	UK
	Technische Universität Berlin (TUB)	DE
	Rheinisch-Westfälische Technische Hochschule Aachen	DE
	Météo-France	FR
	Cranfield University	UK

SCRATCH

Services for CollaboRative SMEs Aerospace Technical research

Background

Since early 99, aeronautical SMEs beneficiate from the free support of the SCRATCH methodology through successive stimulation actions funded by the EC. Since then, 5000 SMEs have been directly contacted, 450 have been audited and 160 research expressed interests have been collected. SCRATCH has serviced 64 SME proposals submitted to FP5 and FP6 aeronautics calls, out of which 28 have led to funded projects, demonstrating the efficiency of the SCRATCH approach to the benefit of SMEs technological acquisition in Aeronautics.

Project objectives

- Inform the widest possible number of European SMEs within the aeronautics supply chain about the research funding mechanisms offered by the EC Framework Programme (FP) and provide these SMEs with new opportunities of Technology Acquisition through the submission of STREP proposals to FP6 aeronautics calls.
- Audit candidate SMEs, in order to help them structuring their corporate research plan and identifying jointly the technology acquisition themes able to be acquired through a collaborative RTD project (STREP) within the FP6 Aerospace Programme.
- Set up a list of short-term, product oriented, research needs expressed by Aerospace SMEs and identify possible STREP proposals to be submitted to forthcoming FP6 Aeronautics calls.
- Service at least 15 aeronautics SME-led STREP proposals, helping the initial consortium in the definition, preparation and submission of its proposal.
- Enrich the European Aerospace SMEs data base, in cooperation with ASD and the AeroSME project.
- To undertake investigations dealing with aerospace SMEs needs and capabilities in view of the Framework Programme 7 preparation.

Description of work

SCRATCH approach focuses on 4 main activities:

- **Awareness Campaign:** Through a wide information action, a large number of Aerospace SMEs within 20 European countries (Member States or Associated Countries) will be informed about:
  - the opportunities offered by the 6th FP to fund collaborative research activities and
  - about the service offered by SCRATCH to help SMEs to express their technology acquisition needs and prepare a STREP proposal when appropriate.
- **Audit of European Aerospace SMEs:** Companies having expressed their interest during the awareness campaign are audited and invited to express their technology acquisition needs.
- **SMEs expressed RTD needs:** The technology acquisition needs expressed by European Aerospace SMEs are collected and analysed (taking into account the coordination capabilities of the initiating SME), in order to identify possible the aeronautics SME-led STREP proposals to be submitted to FP6 Aeronautics calls.
- **Project Proposals Servicing:** SCRATCH partners will support candidate STREP proposals through all the preparation stages from project definition to proposal submission, including partners search, advice on management and work plan organisation, guidance on proposal quality improvement, support on administrative and legal issues, ...)

The support offered to SMEs by SCRATCH partners build upon the already long experience of the project core team. This experience will be summarized during the current project phase in an handbook on "Implementation of quality guidelines in SME support activities". It will allow implementing in a structured way at each stage of the SCRATCH support (SMEs' audits, candidate proposals selection, proposals servicing, ...) the best practices and the quality guidelines acquired by the consortium.

- 4000 SMEs will be contacted by mail in the sixteen countries directly covered by the SCRATCH Partnership, forums will be organized in cooperation with AECMA AeroSME.
- 200 SMEs will be audited.
- 50 expressed ideas of RTD coming from SMEs must be collected.
- 15 collaborative RTD STREPs coordinated by SMEs and serviced by SCRATCH partners will be submitted to FP6 aeronautics calls.

Expected Results

Acronym:	SCRATCH	
Contract No.:	ASA3-CT-2004-510981	
Instrument:	Specific Support Action	
Total Cost:	€710 000	
EU Contribution:	€660 000	
Starting Date:	01/05/2004	
Duration:	24 months	
Website:	www.aero-scratch.net	
Coordinator:	Euro Inter 33 Boulevard Deltour FR-31500 Toulouse	
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Partners:	Euro Inter Toulouse	FR
	PRO Support B.V.	NL
	T4TECH s.r.l.	IT
	RHEA System S.A.	B
	Fundación INASMET	ES
	Euro Consultants Ltd.	IL
	Europus Ltd.	UK
	Aktionsgemeinschaft Luft- und Raumfahrtorientierter Unternehmen in Deutschland e.V. (ALROUND)	DE

Institute of Structures and Advanced Materials (ISTRAM)	GR
tekever lda	PT
Institutul National de Cercetari AeroSpatiale 'Elie Crafoli'	RO
Instytut Lotnictwa	PO
Univerzita Tomáše Bati ve Zlíně (UTB)	CZ
Centre Technologique en Aérospatiale	CAN
Enterprise Ireland, Irish Aeronautics & Space Research Network (IASRN)	IRL
Rymdtekniknätverk Ekonomisk förening (RTN)	SE
SLOT Consulting Ltd.	HU

ANASTASIA

Airborne New and Advanced Satellite techniques and Technologies in a System Integrated Approach

Background

In the first 20 years of the 21st century, air traffic is expected to approximately double in volume.

Future satellite-based navigation and communication systems should play a central role in this domain, allowing increased efficiency of airspace use, which will in turn help increase airspace and airport capacities and consequently the overall efficiency of air transport in carrying more passengers safely. In addition, the better management of airspace and time spent in flight will have a positive impact on air pollution, noise and fuel consumption.

Project objectives

The core of ANASTASIA research is to provide on-board Communication Navigation and Surveillance (CNS) solutions to cope with the foreseen doubling of air traffic by 2020.

In the navigation domain, ANASTASIA will carry out research to define technology and system architectures for the navigation function, which is expected to allow the development of a new generation of airborne GNSS receivers for all phases of flight. Such systems will offer accurate and safe global navigation while reducing the avionics cost through the optimisation of the number and complexity of onboard equipment.

On the communication side, the work will be focused on the design and implementation of a prototype, an affordable aeronautical satellite communications system that will meet the evolving European ATM requirements. Research will also be made into higher bandwidth services, systems and airborne equipment to meet impending aircraft communication requirements efficiently, including both future ATM and passenger needs.

The future needs of surveillance will be consolidated with the requirements and key technology prototypes from communications and navigation.

Description of the work

The work is divided into six main Sub-Projects (SP), the objectives of which are the following:

Project management (Sub-Project 1): To manage the consortium, report to the Commission and ensure coordination amongst the partners.

Needs and Aircraft Requirements (Sub-Project 2): The objective is to identify the requirements for future CNS functions for both business jets and air-transport, and to propose candidate architectures for the new satellite based navigation and communication systems. Towards the end of the project, the initial trade-off matrix between the architectures will be updated to take into account the results of the technology studies and flight trials performed in Sub-Projects 3, 4, and 5.

Space-Based Navigation Technologies (Sub-Project 3): This Sub-Project will investigate the techniques and technologies that must be implemented for optimal use of the new Global Navigation Satellite System, including GPS and GALILEO constellations, in a future on-board navigation system. The investigated solutions will include antenna design, advanced signal processing, receiver integration and hybridisation techniques with low cost inertial sensors.

Space-Based Communication Technologies (Sub-Project 4): The aim of this Work Package is to identify and describe the optimum system that could provide the on-board communications services. The overall system will be defined, then the activities will be focused on the design, prototype and evaluation of the critical technologies for the on-board part.

Operational Characterisation and Evaluation (Sub-Project 5): The central activity of the work package is to verify, in a quasi-realistic environment, the behaviour and performance of key navigation and communication technologies. Most of the performances will be assessed in simulation or lab tests, but for the most critical tests, the assessment will be made through flight tests.

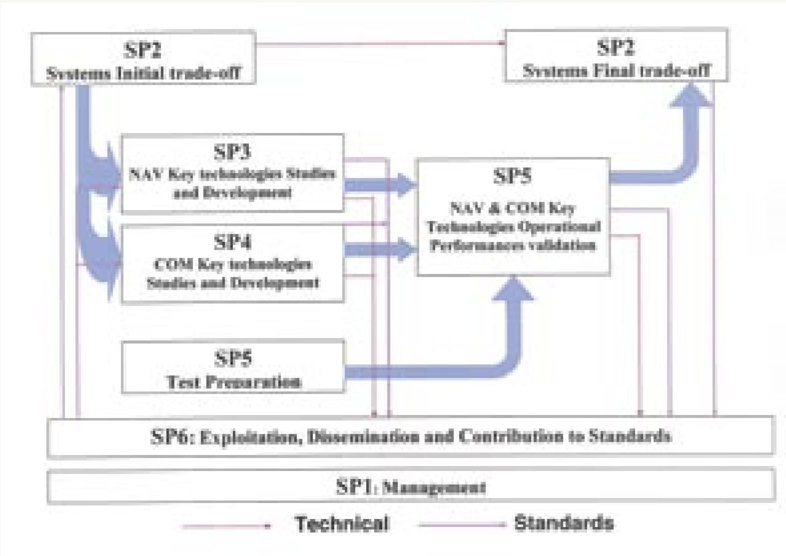
Dissemination (Sub-Project 6): Throughout the project, the ANASTASIA results will be presented to a number of stakeholders in order to ensure that all their requirements have been taken into account, and to contribute to the establishment of the future standards and regulations in the on-board, satellite-based avionics domain.

Expected results

The work conducted in the ANASTASIA project ranges from the elaboration of operational needs to simulations and flight trials with validated avionics architectures and key technologies.

The main goal is to pave the way for the introduction of new satellite-based technologies into aircraft operations, in both navigation and communication.

The main outcome of ANASTASIA will be recommendations for future civil aircraft operations, and a set of evaluated technologies and avionics architectures achievable from 2010 that will enable a more autonomous, satellite-based aircraft operation.



Sub-projects breakdown

Acronym:	ANASTASIA
Contract No.:	AIP4-CT-2005-516128
Instrument:	Integrated Project
Total Cost:	€19 628 427
EU Contribution:	€11 088 000
Starting Date:	01/04/2005
Duration:	48 months
Coordinator:	THALES-AVIONICS 105 Av du gal Eisenhower BP 1147 FR-31036 TOULOUSE cedex
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	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE

Dassault Aviation S.A.	FR
Airbus Deutschland GmbH	DE
THALES Avionics Ltd.	UK
EADS ASTRIUM S.A.S.	FR
EADS CCR	FR
EADS Deutschland GmbH	DE
Selenia Communications S.p.A.	IT
Ascom (Switzerland) Ltd.	CH
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Institut National des Sciences Appliquées de Toulouse	FR
ERA Technology Ltd.	UK
Joanneum Research Forschungsgesellschaft GmbH	AT
Imperial College London	UK
SIREHNA	FR
Skysoft Portugal – Software e Tecnologias de Informaçao S.A.	PT
Data Respons Norge AS	NO
Technische Universität Braunschweig	DE
University of Surrey	UK
Universidade de Vigo	ES
GateHouse A/S	DK
University College London (UCL)	UK
RHEA System S.A.	BE
Russian Institute of Space Device Engineering	RU
Geo-ZUP Company	RU
TriaGnoSys GmbH	DE
THALES Research and Technology (UK) Ltd.	UK
Wireless Intelligent Systems Ltd.	UK

HASTAC

High Stability Altimeter System for Air Data Computers

Background

The project responds to the challenge of ensuring that, irrespective of the growth of air traffic, air transportation will be safer. HASTAC contributes to one of the major challenges identified in the Strategic Research Agenda for European aeronautics. Referring to incidents like 11 September, the SAS plane in Milan Airport and the in-air crash at Bodensee, the European avionics industry has focused on development programmes that improve this type of safety.

HASTAC will contribute to improved safety in different flight situations:

– On-board technologies for prevention of controlled flight into terrain.
– Technologies enabling a full and permanent automatic approach and landing in all weather.
– On-board technologies for in-flight and on-ground collision avoidance novel concepts.
– Techniques enabling the development of improved aviation safety metrics.

Project objectives

The main project strategic objective is to increase the safety in all in-flight situations, particularly low visibility situations, by improving the transducers used in Air Data Computers (ADC) for aircraft applications. The results are relevant to flying on autopilot in the reduced vertical separation minima of 1 000ft, as well as

to demanding manual flying situations in darkness and low visibility. In transponder applications, the project will give significantly increased reliability in altitude information for manual and automated Air Traffic Control systems. Aircraft Traffic Collision Avoidance Systems will also benefit from more accurate and reliable altitude information, which will allow the automated avoidance instructions to be more accurate and effective.

Description of the work

The work is divided into five Work Packages.

Work Package 1: Sensing element: Development of an absolute pressure-sensing element in silicon (MEMS) with a minimal number of unidentified error sources featuring excellent long-term stability and high repeatability in aerospace applications.

Work Package 2: Pressure sensor package: Development of a new hermetic pressure sensor package that minimises transfer of unwanted forces to the silicon-sensing element developed in Work Package 1.

Work Package 3: Transducer: Development of an optimised digital altimeter transducer based on the packaged sensor with a long-term stability specification better than 0.01%FS/year.

Work Package 4: Air-Data Computer Unit: Development of a new digital air data computer unit that will utilise the improved accuracy in altimeter barometric measurements from the developed transducer.

Work Package 5: Aircraft flight test: Demonstration of the improved safety performance by real helicopter flight tests.

Expected results

The project will develop a new generation of air data computers (ADC), suitable for fixed wing and rotary wing applications, which will give altitude accuracy capabilities significantly improved over those available today. Aircraft flight-testing performed in the project will demonstrate the effectiveness of the performance improvement. A new generation of transducers with a new microsensor (absolute pressure sensing element) as the key component, will also be available for other application areas, such as transponders.

Acronym:	HASTAC
Contract No.:	AST4-CT-2005-012334
Instrument:	Specific Targeted Research Project
Total Cost:	€2 895 000
EU Contribution:	€1 500 000
Starting Date:	11/01/2005
Duration:	30 months
Website:	www.hastac.biz
Coordinator:	STIFTELSEN FOR INDUSTRIELL OG TEKNISK FORSKNING VED NORGES TEKNISKE HOGSKOLE (SINTEF) Strindvegen 4 NO-7465 Trondheim

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	Eurocopter SAS	FR
	Messier Bugatti	FR
	Thales Electronic Engineering GmbH.	DE
	Brno University of Technology	CZ
	ACORDE	ES
	Centre Suisse d'Electronique et de Microtechnique	CH
	TELETEL S.A.	HE
	Warsaw Institute of Technology	PL
	Saarland University	DE

WISE

Integrated Wireless Sensing

Background

Current aircraft monitoring systems use sensors that are hard-wired to their electronic acquisition unit.

- It precludes acquisition of major parameters where wires cannot be installed.
- It results in complex installation.
- It very often results in increased weight.

Current wireless technologies enable an easy and flexible installation, but their design does not match aircraft monitoring needs as:

- autonomy is limited and re-charging is required
- compatibility is not reached in the harsh aircraft environment.

Matching aircraft constraints and power autonomy are targets to be met by wireless monitoring systems operating at low data rates.

WISE will investigate ways to integrate wireless technologies in the aircraft systems environment, for which the sensor power supply has to be autonomous.

WISE technologies will be usable in any fixed-wing aircraft or rotorcraft.

Project objectives

- To enhance aircraft system monitoring by developing concepts based on new wireless technologies and integrated sensing solutions, which have autonomous sensor power and low consumption, and are compatible with the harsh environment of aircraft systems.
- To allow the monitoring of new parameters, or replace/simplify complex existing solutions with physical links (wire, fluid).
- To allow continuous monitoring or improve redundancy when the link with the physical solutions would have been severed or turned off to improve information segregation.

All this will lead to improvements in aircraft design, maintainability, availability and the associated costs, reduced weight, fuel consumption and emissions.

Description of the work

The objective of the work is to develop three kinds of technologies:

1. a Radio Frequency (RF) transmission through the open air medium that can remotely power the sensing element.

2. a RF transmission through a complex environment comprising a metallic or composite aircraft structure. This technique should allow communication coverage through the air within the complete aircraft.

Self-power generation will be investigated and could be integrated at the sensor level.

3. a technique capable of energy and data transmission through a close metallic envelope. Non-RF techniques, such as the ultrasonic technique, will be investigated, including coupling with power generation techniques.

The performances of these technologies will be verified by simulation, laboratory testing and finally by ground measurements on an iron bird for RF technologies.

Expected results

The results expected are to have proven technology available for future programmes and products and to export to the non-aeronautical industry.

WISE intends to contribute to the standardisation of wireless technology usage in the aircraft.

Acronym:	WISE
Contract No.:	AST4-CT-2004-516470
Instrument:	Specific Targeted Research Project
Total Cost:	€4 918 909
EU Contribution:	€2 821 346
Starting Date:	01/01/2005
Duration:	36 months
Website:	www.wise-project.org
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	THALES Electronic Engineering GmbH	DE
	Brno University of Technology	CZ
	Advanced Communications Research and Development S.A.	ES
	Centre Suisse d'Electronique et de Microtechnique S.A.	CH
	TELETEL S.A.	EL
	Politechnika Warszawska (Warsaw University of Technology)	PL
	Universität des Saarlandes	DE

ATPI

High Performance Damping Technology for Aircraft Vibration Attenuation and Thermo-Phonic Insulation

Background

In an aircraft, the vibration and human sensitive frequency excitation come from the exterior (engines, aerodynamic flow turbulence on airplane skin, propellers for turbo-proprelled aircraft) and the interior (air-cooling). Classical solutions are used (glass wool, tuned mass system) but they have inherent drawbacks.

ARTEC has developed a low profile shape of its proprietary SPADD® technology, which present vibro-acoustic performances much better than the classical solutions. However, the SPADD® 'surface' needs to become suitable for aerospace use and more research is necessary.

Project objectives

The objective of the ATPI project is to propose complementary and/or alternative solutions to the existing acoustic treatments against external sources to reduce the level of operating vibration notably and to improve the noise reduction on a large frequency band.

These solutions are based on the ARTEC surface technology. As is the nature of the various materials used in this technology in a performing role, they cannot be removed and replaced easily. Some interactions with the geometry must be anticipated and will be addressed. The new design will be verified with the help of prototype testing to:

- Find replacement materials suitable for this technology and at the same time investigate the re-design of the technology itself, in order to comply with the new material, to maintain the expected damping performances. The use of visco-elastic polymer and cork materials is already envisaged, the latter having good thermal insulation properties. A low profile requirement is kept as mandatory.
- Develop specific damping technology, complementary to the existing blanket, which is able to provide a high thermo-phonic insulation.

The final objective of ATPI is to increase the comfort of aircraft passengers by drastically reducing the noise coming from the exterior.

Description of the work

The technical work can be split as follows:

1) Setting up a technical requirement specification in order to clearly identify the technology characteristics needed. This will be done with the help of Airbus as an end user.

2) Study of vibration attenuation and acoustic insulation by adapting the SPADD® Surface technology. This must be done while maintaining the optimum combination of acoustic and vibration treatment to reach the attenuation required in the specification previously established.

3) Specific study of the necessary materials (visco-elastic polymer, cork) in order to define the thermal and damping properties. This is necessary for designing an efficient vibration attenuation layer, which is well suited to aeronautical specifications. Cork properties will also be studied for designing an efficient thermo-phonic layer for the same

purpose. Compatibility between the envisaged materials will be addressed as well as their behaviour.

4) Fabrication of samples of the new device.

5) Validation of properties and performance of the samples for aeronautical use. This will be done using standard aeronautical testing methods.

In addition, some standard tasks like the dissemination of results will be carried out.

Expected results

The main expected result of the ATPI contract is the development of a new product, more efficient than those already in existence, to be used for thermo-vibro-acoustic protection inside an aircraft with:

- increased damping performance for vibration and noise
- smaller weight than conventional devices of similar performance
- high spin-off potential for aeronautics, when a large temperature range becomes possible for the damping technology.

Some more expected improvements because of this main result would be:

- advanced know-how in thermo-vibro-acoustic technologies
- new materials for thermo-vibro-acoustic attenuation, opening new applications
- improved passenger and crew comfort, leading to a reduction of crew stress and an increase in safety
- reduction of aircraft weight
- increased structural life.

Acronym:	ATPI	
Contract No.:	ASTC4-CT-2004-516057	
Instrument:	Specific Targeted Research Project	
Total cost:	€1 049 264	
EU Contribution:	€650 000	
Starting date:	01/12/2004	
Duration:	18 months	
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	Catherineau S.A.	FR
	Société des lièges HPK S.A.	FR
	Université de Liège	BE
	OPTRION	BE
	Euro Inter Toulouse	FR

ICE

Ideal Cabin Environment

Background

ICE addresses the widespread concerns about the impact of flying on the health and well-being of passengers. Changing passenger demographics, the advent of ultra-long-haul services, and specific health issues such as Deep Vein Thrombosis (DVT) and Severe Acute Respiratory Syndrome (SARS), have all combined to increase concerns. Earlier studies have been fragmented and, significantly, have not determined the health-based optimum levels or studied the synergistic effects of cabin environmental parameters, nor studied cabin pressure, hypoxia (often considered the most serious single physical hazard) and possible links with DVT.

Project objectives

The key objective of ICE is to provide airframers/airlines with step-change knowledge and innovations to address the concerns about the unknown combined effects of cabin environmental parameters, including for the first time cabin pressure, on the health of passengers in commercial aircraft.

Description of the work

ICE will produce step-change knowledge by investigating impacts of varying levels of parameters on subjects using unique large-scale aircraft cabin environment facilities (BRE's ACE and IBP FTF), and will determine optimum individual and combined levels for human well-being, validated by in-flight monitoring. From these, ICE will develop radical predictive design models for airframers and airlines to provide, for the first time, a means by which they will be able to determine the health impact of their aircraft on their passengers.

Expected results

The predictive model will not only consider environmental parameters but also passenger profile and flight characteristics. If these indicate health risks, the user will be able to vary individual or combined parameters to minimise risks to acceptable levels in a technically feasible and economically viable manner. ICE will also draft relevant standards, including the first scientifically based standard for cabin pressure, and provide practical design guides and operational recommendations in co-operation with stakeholders.

Acronym:	ICE
Contract No.:	FP6-2003-AERO-1-561131-ICE
Instrument:	Specific Targeted Research Project
Total Cost:	€5 932 151
EU Contribution:	€4 078 275
Starting Date:	03/10/2005
Duration:	36 months
Website:	http://projects.bre.co.uk/ICE (provisional)

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Avitronics Research	EL
Civil Aviation Authority (CAA) - Aviation Health Unit	UK
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
EADS Deutschland GmbH	DE
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	DE
Medical University of Vienna	AT
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Royal Free and University College Medical School	UK
Streit Technische Gebaüde Ausrüstung	DE
Carl von Ossietzky Universität Oldenburg	DE
Università degli Studi di Padova	IT
České vysoké učení technické v Praze (ČVUT)	CZ

ADLAND
Adaptive Landing Gears for Improved Impact Absorption

Background

The motivation for this research is to respond to requirements for high impact energy absorption in landing gears. Typically, shock absorbers are designed as passive devices with characteristics adjusted either to the most frequently expected impact loads or to ultimate load conditions. However, in many cases the variation of real working conditions is so high that the optimally designed passive shock absorber does not perform well enough.

In contrast to the passive systems, the proposed research focuses on active adaptation of energy absorbing structural elements, where a system of sensors recognises the type of impact loading and activates energy absorbing components in a fashion that guarantees optimal dissipation of impact energy.

Project objectives

The project objectives are:

– to develop a concept of adaptive shock-absorbers
– to develop new numerical tools for the design of adaptive vehicles and for the simulation of the adaptive structural response to an impact scenario
– to develop technology for actively controlled shock-absorbers applicable in landing gears (there are two options: Magneto-Rheological Fluid-based (MRF) and Piezoelectric Valve-based).
– to design, model and perform repetitive impact tests of the adaptive landing gear model with high impact energy dissipation effects
– to design, produce and test in flight the chosen full-scale model of the adaptive landing gear.

Description of work

Work Package 1: Description of the state-of-the-art. Analysis of statistics and specification of life-cycle requirements. Determination of hardware/software requirements for adaptive shock-absorbers. Definition of necessary safety aspects to be considered.

Work Package 2: Development of methodology and the corresponding software tools for simulation of adaptive landing scenarios. Development of software tools for modelling and design of adaptive shock absorbers (Piezo- and MRF-based). Creation of numerical models and computer simulations for case studies. Design of magnetic circuits for MRF-based shock-absorbers and the design of MRF-based shock absorber. Design of Piezo-valves, fluidic circuits, driving electronics and the complete PD -based shock absorber. Design of landing gear shock absorbers using 3D CAD systems (Solid Edge and Nastran systems) and test equipment.

Work Package 3: Elaboration of sensing system for impact prediction, detection and identification (software and hardware). Fabrication of real-time controller for shock absorbers. Design and fabrication of MRF and Piezo-valve based lab-scale models of shock absorbers. Fabrication of full-scale model of adaptive shock absorber. ALG system integration (software, hardware and driving electronics). Hardware controller fabrication.

Work Package 4: Evaluation of the requirements from the ALG to the MR fluid properties. Characterisation of application-relevant MR fluid properties like base viscosity, field-dependent shear stress, temperature behaviour, sedimentation stability, etc. Development of an MR fluid adapted to the requirements of the ALG. Development of specific testing procedures, which are necessary to evaluate the MR fluid behaviour for use in the ALG. Supply of MR fluid in quantities of some litres for tests in the shock absorbers.

Work Package 5: Small lab tests with MRF and Piezo-valve based shock-absorbers. Full-scale lab tests with landing gear equipped with MRF and/or Piezo-valve based shock absorbers. Validation of the real-time control techniques. Verification of software tools vs. experiment.

Work Package 6: Flight testing. Evaluation of flight test results.

Expected results:

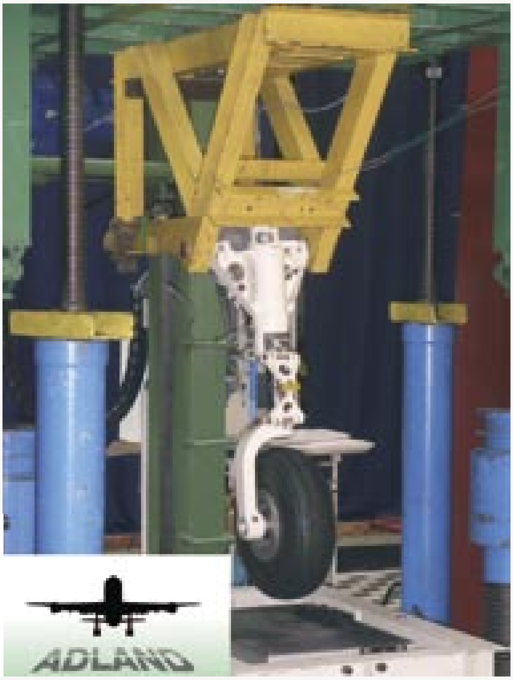
1. Specifications determined in Work Package 1 will be used as the starting point in further Work Packages.

2. The control part of the software will be used as an ALG controller in lab-tests

3. Software-hardware integration will be made after lab-tests. Hardware controller will be manufactured. Decision about the most promising ALG technology will be taken.

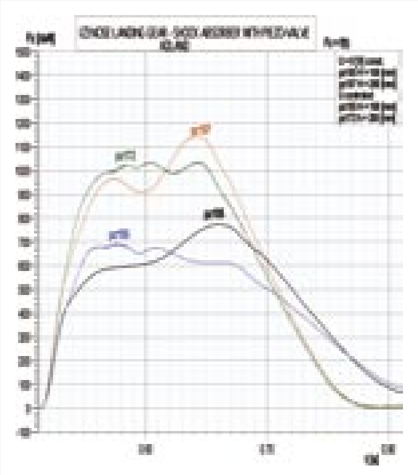
4. MR fluid with the desired properties will be produced and supplied for testing in lab-testing installations and in full-scale models

5. The control software (installed in notebook) and ALG hardware will be tested. After positive verification vs. experiment, integration of the ALG system will be made and the hardware controller will be produced. Decisions concerning ALG hardware will be made.



Load on the active landing gear prototype in comparison with a load on a passive landing gear.

Load on the active landing gear prototype in comparison with a load on a passive landing gear



Black line: low impact energy, passive shock absorber
Blue line: low impact energy, active shock absorber
Red line: high impact energy, passive shock absorber
Green line: high impact energy, active shock absorber

Acronym:	ADLAND	
Contract No.:	AST3-CT-2004-502793	
Instrument:	Specific Targeted Research Project	
Total Cost:	€3 006 352	
EU Contribution:	€1 772 390	
Starting Date:	01/12/2003	
Duration:	36 months	
Website:	http://smart.ipt.gov.pl/adland	
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Partners:	Institute of Fundamental Technological Research (IFTR)	PL
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	Instytut Lotnictwa	PL
	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	DE
	Cedrat Technologies S.A.	FR
	University of Sheffield	UK
	Messier-Dowty S.A.	FR

MESEMA

Magnetoelastic Energy Systems for Even More Electric Aircraft

Background

This technology-orientated research programme builds upon the success of previous EU projects devoted to accomplishing the objectives of the aeronautics priority through designing and testing 'innovative transducer systems based on active materials'. The objectives came from a spontaneous evolution of the research activities developed by the two consortia related to the European research programmes named MADAViC (Magnetostrictive Actuators for Damage Analysis and Vibrations Control) and MESA (Magnetostrictive Equipment and Systems for More Electric Aircraft).

Project objectives

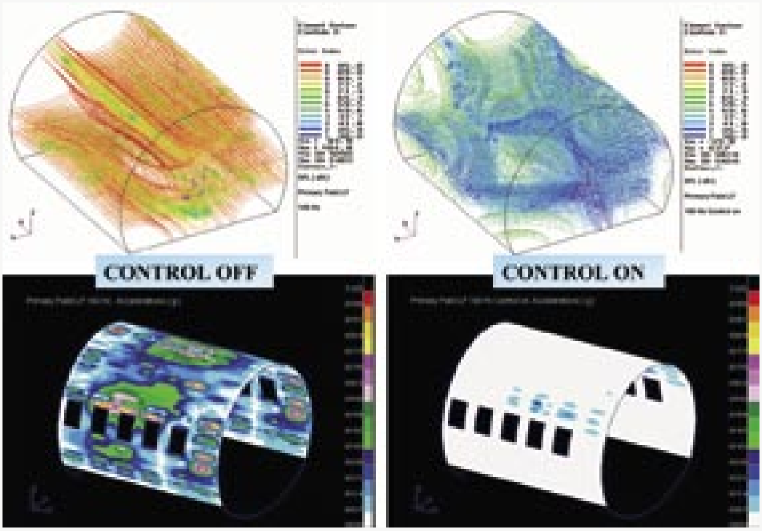
The objectives mainly consist of the design and development of systems integrating vibration transducers based on active components. The main targets are represented by the design and development of five systems aimed at 1) reducing the level of disturbance noise in turbofan aircraft, and 2) in helicopters, 3) examining the health status of aircraft structural components, 4) replacing the helicopter rotor blade pitch angle actuation systems and 5) transforming mechanical energy related to vibration fields within an aircraft into electric energy. These five objectives have a common aspect that suggested their integration within this project: they all require the design and development of a dedicated actuation system (including control algorithms and driving electronics) providing dynamic displacement and force fields on a host structure. Four fixed and rotary-wing aircraft companies accompanied by SMEs and university research institutes will take part in and benefit from the development of primarily magnetoelastic transducers for high-torque actuation, vibration and noise reduction, electrical energy generation and structural health monitoring.

Description of the work

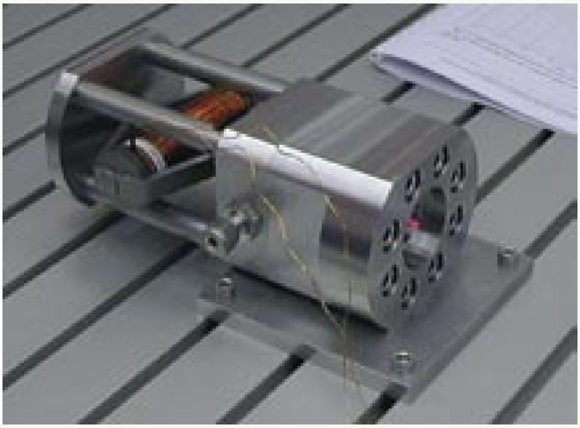
The work plan is divided into seven Work Packages, the first of which focuses on the research aspect of magnetoelastic materials and related technology. This Work Package feeds all of the technical development Work Packages (numbers 2-5) with information regarding materials but also keeps the consortium abreast of the state-of-the-art in the area of smart materials and structures. Moreover, Work Package 1 also supplies Work Packages 2 and 4 with the hardware development results – the hysteresis compensation module – for use in the two Noise and Vibration Control (NVC) applications. Work Package 2 is concerned with NVC and contains two development activities, one for improving the cabin environment in turbofan aircraft by reducing noise levels through the application of magnetostrictive devices on the structural members, and the second one involving the development of smart force generators for combating vibrations in helicopter cockpits. Work Package 3 is a relatively small-scale activity in the development of health monitoring (HM) algorithms for aeronautical systems incorporating active devices. This work represents an added value on two levels: firstly, the investigation approach involves the use of existing NVC devices for investigating structural integrity; secondly, and as a direct consequence of the first level implications, the actuators and electronics integrated in the large-scale mock-up of Work Package 2 can be implemented for the HM activities with little cost regarding additional hardware. Work Package 4 involves the development of a high-torque actuation solution for root control of helicopter rotor blades – a big challenge, demanding and promising innovative solutions. This actuation approach can solve the problem of Individual Blade Control (IBC), which is a proven method of reducing helicopter vibrations but also improving fuel efficiency. Work Package 5 focuses on the latest innovation, the generation of electricity from the energy in vibrating structures. By their nature, such 'Vibel' devices will also dampen vibrations and therefore allow a fruitful interaction between Work Packages 5 and 2. Finally, the last two Work Packages (6 and 7) serve to coordinate the exploitation activities, and to manage the overall Project from an administrative and technical point of view.

Expected results

The consortium expects to design and produce one or more working systems for each of the five selected applications. For noise/vibration control and health monitoring applications, a full-scale working system is expected to be tested on a laboratory test article (fuselage mock-up). As far as helicopter blade control is concerned, one or more proofs of concept will be developed. Finally, many VIBEL prototypes will be produced in order to investigate aspects of transduction of mechanical into electrical energy employing active materials, including storage of this energy.



Acronym:	MESEMA
Contract No.:	AST3-CT-2003-502915
Instrument:	Specific Targeted Research Project
Total Cost:	€7 633 149
EU Contribution:	€5 474 172
Starting date:	01/01/2004
Duration:	36 months
Website:	www.mesema.info



Active magnetostrictive valve to be implemented within the high torque actuation system for helicopters application

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	Seconda Universitá degli Studi di Napoli	IT
	Alenia Aeronautica S.p.A.	IT
	EADS Deutschland GmbH	DE
	ZF Luftfahrttechnik GmbH	DE
	TACT Scientific Consulting Ltd.	IE
	Cedrat Technologies S.A.	FR
	Chalmers Tekniska Högskola AB	SE
	Eurocopter Deutschland GmbH	DE
	National Institute of Research and Development for Technical Physics	RO
	Kungliga Tekniska Högskolan (KTH)	SE
	University of Patras	EL
	Mecel AB	SE
	Newlands Technology Ltd.	UK
	Paragon Ltd.	EL
	University of Salford	UK

PIBRAC
Piezoelectric Brake Actuators

Background

PIBRAC complies with the strategic objective 'Open Upstream Research for strengthening the competitiveness of the aeronautical industry in the global market', responding to the challenge of delivering more economical, higher performing and better quality products and services. It addresses the strategic objective "of reducing the operating costs by 20% and 50% in the short and long term" through reduction in weight, peak energy demand for braking at landing and of maintenance costs of brakes.

PIBRAC will develop two approaches, with a medium-term perspective for rotational actuator design and a long-term one for linear design.

Project objectives

Emerging high-power, piezoelectric vibration motor technology, thanks to its high torque/force – low-speed characteristic, high-power density and very low inertia, could lead to overcoming the drawbacks (peak power demand, mass) of EMA fitted with electromagnetic motors.

The aim of PIBRAC is to run specific research, on the basis of existing research results on high-power piezoelectric motors, and to carry-out specific research and validation that will allow the use of this promising technology in aircraft brake actuators. The general PIBRAC objective is to demonstrate the feasibility of a piezoelectric brake actuator, including power electronics and the control system. Two different actuator configurations will be considered: for the rotational configuration, two prototypes will be built and tested, while work for the linear configuration will be limited to paper study and modelling. A final technical and economic evaluation of these piezoelectric brake actuators will be provided.

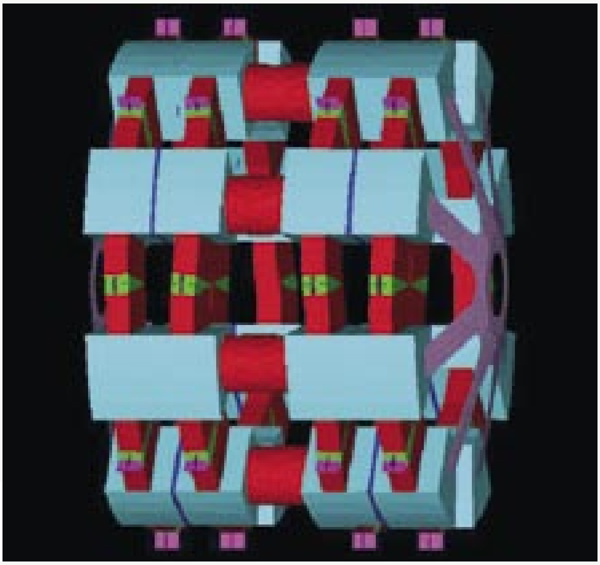
Description of the work

The PIBRAC's objective is to study, design and test an innovative type of piezoelectric brake actuator and its control electronics. PIBRAC is a three-year project divided into five Work Packages that include specifications and assessment criteria, research on different functions, technology integration, technology evaluation and results dissemination. They will address both configurations of actuators, which will be studied in parallel, with a final assessment presenting conclusions on each technology and on the comparison of both. The reason for this approach is that partners are convinced that there is a high chance of success for the rotational actuator, while the linear actuator may require complementary work with higher risk because nothing exists in this domain at the required power level.

The main topics to be addressed are:

- architecture of brake actuator with piezoelectric motor
- wear of the friction surfaces of piezoelectric elements inside the motor
- elimination of mechanical jamming of internal parts in case of motor failure
- electrical power management
- high-frequency control of piezoelectric motor
- test of validation models.

The PIBRAC consortium gathers all the skills needed from research establishments to components manufacturers and an aircraft manufacturer. It is led by SAGEM, a worldwide equipment company. It includes Airbus, the world's leading aircraft manufacturer, Messier Bugatti, a worldwide aeronautic equipment provider, BAM, a renowned material



Rotational motor

research centre, NOLIAC, a competitive piezoelectric component manufacturer (SME), two specialised SMEs in modelling, electronics and testing, and two technical universities specialised in control electronics and R&D result dissemination. The necessary critical mass of competencies is reached within this relatively compact grouping of skilled partners. This is rather unique, considering the number of new technologies and testing facilities required.

Expected results

PIBRAC work will help to overcome the critical issues of a new technology and will demonstrate the ability of this emerging, high-power, piezoelectric motor technology to be applied to brake actuation. The expectation is to demonstrate, when compared to an EMA, a great improvement as regards compactness and power delivered: a weight, including the power electronics, reduced by a factor of two and a peak energy power demand reduced by at least a factor of three and hopefully five.

Acronym:	PIBRAC
Contract No.:	AST4-CT-2005-516111
Total cost:	€5 204 499
EU Contribution:	€3 106 214
Starting Date:	01/02/2005
Duration:	36 months
Website:	www.pibrac.org
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Partners:	SAFRAN S.A.	FR
	Airbus UK Ltd.	UK
	Bundesanstalt für Materialforschung und Materialprüfung (BAM)	DE
	Messier-Bugatti	FR
	Instituto de Engenharia Mecanica e Gesto Industrial (INEGI)	PT
	Noliac A/S	DK
	Universität Paderborn	DE
	SAMTECH S.A.	BE
	Á. Brito, Industria Portuguesa de Engenagens, Lda.	PT
	Institute of Mechanics of Materials and Geostructures S.A.	EL
	Skoda Vyzkum s.r.o.	CZ

RETINA

Reliable, Tuneable and Inexpensive Antennae by Collective Fabrication Processes

Background

Today, aeronautical broadband services enabled by satellites are becoming a reality. The services, which are or will be offered using these broadband data links, range from increasing passenger comfort (live-TV, Internet on-board) to providing real-time ATM functions (in-flight monitoring) and improving safety/security aspects (live video-connection to ground). Current aeronautical antenna solutions have drawbacks in terms of cost (active phased arrays) or drag (dish antennas).

Project objectives

The project aims to develop a reliable and low cost solution for electrical beam steering in Ku- or Ka-band on-board mobile platforms. It is based on the global concept called ReflectArray and the industrial implementation is clearly a lower cost alternative compared to active phased array antennae. In addition, the quasi-planar integration of these antenna types will produce almost no additional drag. For the key building block of the antenna, the phase shifter, two solutions will be considered in parallel until a decisive milestone is reached to choose the most suitable technology for the final ReflectArray approach:

- high-power handling RF-MEMS technologies
- high-power handling ferroelectric materials.

These two solutions are considered by the consortium to be the best technical alternatives for phase shifting up to Ka-band today and are predicted to increase their performance levels while keeping costs at the lowest level, because of their full compatibility with collective fabrication processes.

Description of the work

Initially, the complexity of the application will be addressed at the system level by looking at the global (operational, functional) requirements for the ReflectArray antenna and at a market analysis about next-generation broadband SatCom services. Based on that, the requirements for the unitary cells of the antenna array and thus for the phase shifters will be derived.

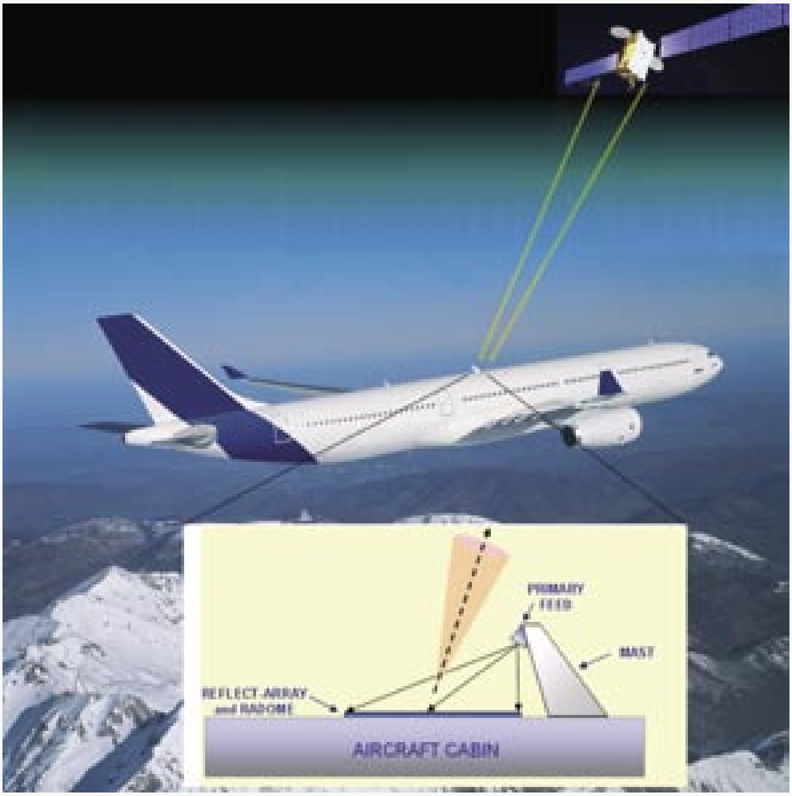
This definition of specifications will be followed by two cycles of modelling and electrical-mechanical design, processing and subsequent characterisation of the two key technologies under investigation (RF-MEMS and ferroelectric material). Possible implementations of the phase shifters range from free-space to guided-wave circuit topologies. After a decisive milestone, the most promising technology will enter into another cycle of development of the optimised phase shifter for the antenna demonstrator.

This demonstrator itself will be a partial ReflectArray antenna. It will consist of 20 to 30 unitary cells, compared to around 1 000 cells envisioned for the future target product. The main commitment is for this demonstrator to be representative of the low cost collective fabrication and assembly method developed throughout the project.

As the demonstrator is for aeronautical applications, high attention is paid during the whole project to the issue of reliability under these demanding conditions in terms of temperature, vibrations and signal strength. Therefore, extensive tests on the reliability of both technologies will accompany the different stages of the project and extra efforts will be made regarding the proper modelling of the main reliability aspects by developing a suitable software tool.

Expected results

It is expected that a clear view about the future of the broadband SatCom market and the requirements for next-generation mobile antennas will be gained. Following these indications, phase shifting circuits, based on the two technologies, will be assessed. Finally, a partial ReflectArray antenna will be built, which will demonstrate the cost-effectiveness and performance of the chosen approach. In addition, a software tool for modelling the main reliability aspects of the RF-MEMS technology will be developed.



Low-profile and low-cost ReflectArray antenna for airborne broadband SatCom applications

Acronym:	RETINA
Contract No.:	AST4-CT-2005-516121
Instrument:	Specific Targeted Research Project
Total Cost:	€5 189 032
EU Contribution:	€3 170 000
Starting Date:	01/02/2005
Duration:	36 months
Website:	http://dolomit.ijs.si/RETINA/
Coordinator:	EADS Deutschland GmbH Corporate Research Centre Germany Dept.: LG-ME DE-81663 Munich
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Partners:	EADS Deutschland GmbH	DE
	THALES Systèmes Aéroportes	FR
	Interuniversitair Micro-Elektronica Centrum vzw	BE
	Swiss Federal Institute of Technology at Lausanne, Ceramics Laboratory	CH
	Coventor S.A.R.L.	FR
	Chambre de Commerce et d'Industrie de Paris – Groupe ESIEE	FR
	Institut Jozef Stefan (IJS)	SI
	HYB proizvodnja hibridnih vezij, d.o.o	SI

SIRENA

External EMC Simulation for Radio Electric Systems in the Close Environment of the Airport

Background

The public and equipment manufacturers are concerned about electromagnetic (EM) radiation effects. In aeronautics, in particular, research has been undertaken, mainly by industry, with the support of research centres and universities, under the theme of 'EM Protection and Compatibility'. Research is still going on in order to acquire understanding of the EM threat in a complex environment (with multiple EM sources and targets). However, progress is still needed to determine, as accurately as possible, the propagation of electromagnetic radiation and its influence on aircraft and exteriors/interiors of airport buildings. There is, therefore, a need to master an extremely precise simulation of the airport environment and of electromagnetic propagation. Currently, several sets of tools exist, some dedicated to airport modelling, others to EMC simulation in the airport vicinity. SIRENA will conduct research on new generation airport modelling tools associated with EM large area method tools.

Project objectives

The first objective of SIRENA is to assess the impact of the EM environment on aircraft, the airfield, airport buildings, and the areas surrounding the airport accurately. The correlated second objective is to address safety and security issues in order to make recommendations for immune emitters and to give advice on the EM airport environment.

In order to achieve the general objectives, the research will focus on intermediate scientific and technical objectives as indicated below:

1. To obtain airfield mock-ups that are as realistic as possible.
2. To obtain an EM source mock-up that is as realistic as possible.
3. To obtain EM field values that are as realistic as possible.
4. To make EM field interpretation as simple as possible.
5. To give recommendation and advice.

Description of the work

SIRENA comprises eight major Work Packages, without counting Work Package 0 (Project Management) and Work Package 9 (Dissemination and Exploitation).

Operational Requirement (Work Package 1) will define the operational scope precisely in terms of size of the environment under scrutiny, types of EM source and types of emission/reception antennas and radars of selected aircraft.

The objective of Technical Requirements (Work Package 2) is to define the technical scope precisely in terms of requirements to fit into the operational requirements.

Exploitation Requirements (Work Package 3) will define precisely the scope for exploitation in terms of scenarios enabling assessment of various situations. These scenarios deal both with simulation and on-site experimentation (Work Package 4, 6 and 7).

Database Modelling (Work Package 4) deals with building a complete 3D synthetic environment through airport/EM source modelling and physical characterisation of this environment. This environment-modelling concept (3D geometry + EM physics) will be tested on the 3D virtual database of Toulouse Blagnac

Airport. The measurement campaign aims to update the simulation process and to validate the technical choices in the tasks Work Package 4.

EM Field Computation (Work Package 5) deals with the definition of efficient means to take into very precise account all the possible 3D EM energy paths from sources to receivers, and to quantify the received EM field levels realistically.

EM Field Analysis (Work Package 6) will develop efficient means (a software tool) to visualise and analyse the complete EM radiation impact on all objects in the airport and its vicinity (humans, on-board equipment, etc.).

Validation (Work Package 7) will consolidate the validity and reliability of the tested simulation in order to support recommendations and advice through a strict validation plan.

Recommendations and Advice (Work Package 8) deals with helping authorities to assess the real risks with regard to safety, security and health in the airfield, airport buildings and the vicinity, and then to give recommendations and advice.

Expected results

- Mastering of fast methods for airfield 3D modelling to achieve a virtual geometrical mock-up and to enhance it with EM physical data to achieve a virtual physical/geometrical mock up.
- Accurate processing of far- and near-field EM diagram to characterise EM sources.
- Acquisition of an efficient and accurate method to assess the 3D EM energy paths from sources to receivers in order to quantify EM field levels at the receiver end.
- Setting up of interactive EM field visualisation enabling a global understanding of EM phenomena in the scope of recommendations for standardisation.
- Provision of aircraft/equipment manufacturers with a solution to characterise the ambient EM field (for accurate modelling of equipment behaviour regarding EM).
- Assessment of the limits of EM interference from the exploitation of the generic parametric simulation.
- Recommendations for immune emitters and advice on EM impact in the vicinity of the airport.

SIRENA aims to provide the means to assess electromagnetic radiation levels in the vicinity of airports, through a combination of exhaustive spatial definition of the areas under scrutiny and detailed EM physics modelling.

Acronym:	SIRENA
Contract No.:	AST3-CT-2003-502817
Instrument:	Specific Targeted Research Project
Total Cost:	€1 930 066
EU Contribution:	€1 171 789
Starting Date:	01/12/2003
Duration:	24 months
Website:	www.aero-scratch.net/sirena.html
Coordinator:	OKTAL Synthetic Environment SAS Immeuble Aurélien II 2, rue Boudeville FR-31100 Toulouse
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Partners:	OKTAL Synthetic Environment S.A.S.	FR
	Airbus France S.A.S.	FR
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Euro Inter Toulouse	FR
	Technische Universität Carolo-Wilhelmina zu Braunschweig	DE
	Institute of Communication and Computer Systems	EL
	IBK Ingenieurbüro Dr. Kretschmar	DE
	IKT System Partner A.S.	NO

SYNCOMECS

Synthesis of Aeronautical Compliant Mechanical Systems

Background

The activities of the SYNCOMECS project will be based on pre-existing software technologies owned by the partners, and on the results of the 5th Framework Programme project SYNAMEC (focused on synthesis of aeronautical mechanisms, from a rigid kinematic point of view). This will guarantee a stable foundation and reduce the risk in R&D activities.

Project objectives

The objective of SYNCOMECS is to build an integrated software suite, using inverse methods, for the design of aeronautical compliant mechanical systems from industrial specifications of functional requirements. The design of these innovative systems poses unique challenges and necessitates the support of advanced prediction software tools, since they should have adequate flexibility to undergo desired deformations under the action of applied forces and adequate stiffness to withstand external loading. The main focus is on generating the topology and dimensions of a compliant mechanical system, starting from input/output force/displacement functional requirements and design constraints. This is a non-linear optimisation problem of a non-linear mechanical system, which may involve one or several flexible components. It will involve Optimisation, Multi-Body Simulation and Non-linear Finite Element Analysis. The solution may be non-existent and, if it exists, not necessarily unique. The software to be developed will be applied to aeronautical industrial problems.

Description of the work

R&D activities will be executed in four steps. Firstly, a full specification of the system will be made. The results of this step will be presented in Milestone 1. The second step will be the development of separate modules and the simultaneous preparation of benchmarking models. The results, as standalone software tools and associated benchmarks, will be validated in Milestone 2. The third step will be the integration of the separate modules within the SYNCOMECS system. The results will be validated in Milestone 3. The fourth step will be the integration of the outcome of evaluations from the end-users. At this level, Milestone 4, the interaction between developers and end-users will lead to the final validation of an integrated environment for synthesis and analysis of compliant mechanical systems.

Expected results

SYNCOMECS will deliver a specialised methodology, which is a compliant mechanisms synthesis (i.e. using optimisation/AI techniques and mechanism/structure modelling techniques concurrently). SYNCOMECS will also deliver a new design tool, which supports compliant mechanical systems design. This specialised methodology and design tool can be exploited in the future by all European industry and also by the European education system.

Acronym:	SYNCOMECS
Contract No.:	AST4-CT-2005-516183
Instrument:	Specific Targeted Research Project
Total Cost:	€1 836 667
EU Contribution:	€1 099 982
Starting Date:	01/04/2005
Duration:	30 months
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Partners:	SAMTECH S.A.	BE
	University of Cambridge	UK
	Technische Universität Clausthal	DE
	Universidad Nacional del Litoral - Instituto de Desarrollo Tecnológico para la Industria Química	AR
	Centre de Recherche en Aéronautique A.S.B.L. (CENAERO)	BE
	CT Ingenieros, A.A.I, S.L	ES
	ABB Sace S.p.A.	IT
	Alenia Aeronautica S.p.A.	IT
	SAFRAN S.A.	FR

COMPACT

A Concurrent Approach to Manufacturing Induced Part Distortion in Aerospace Components

Background

It is not possible to predict part distortion in aerospace components to the required level of accuracy when considering component tolerances. COMPACT is the first initiative to propose a multidisciplinary approach to the prediction and resolution of this problem. Little work has been undertaken in certain areas, others have been ignored, being described as 'black art'. In COMPACT, research will be conducted in the areas of material processing, manufacturing and design, so that a proof of concept can be obtained.

Project objectives

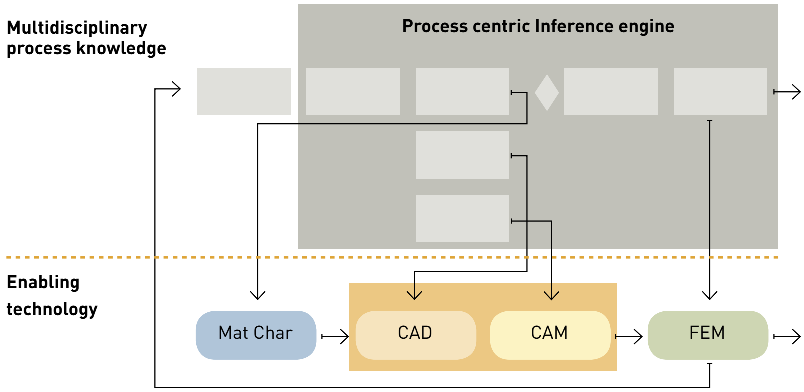
- New knowledge will be created in traditional areas, materials, manufacturing and design. The outcomes of these elements of the project will stand on their own, as with all EU-funded work.
- Finite Element Method technology must be used to simulate the work in each area. New knowledge will be generated to extend the applicability of this technology and achieve greater accuracy in a three-dimensional context. A methodology will be researched and developed that enables the simulations from the three different areas to be integrated. This will enable the prediction of residual stress and distortion due to its redistribution through component design.
- Knowledge-based process engineering will be used as a novel research philosophy. Work undertaken will enable the development of a knowledge-enabled process modelling (KEPE) methodology. Subsequently, a system will be developed, which will demonstrate the re-use of the knowledge gathered from the three areas of expertise. The system will enable engineering compromises to be made in distortion management.

Description of the work

It is estimated that tens of millions of euros are spent every year in an attempt to either avoid or remedy the distortion in components. Part distortion is a function of residual stress and is caused by the complex relationships between material processing, component design and manufacture. The work programme has been developed around these three fundamental streams of research and consequently adopts a truly concurrent approach. Two further research streams will enable the bulk of research findings to be effectively applied to problem solving. Research will be used to gain a greater degree of understanding across the engineering disciplines and create a knowledge base using a process-orientated approach. Finite element modelling will be used to develop three-dimensional functionality that will enable multidisciplinary simulations to be made. The knowledge integration work will use this technology in order to assist or guide cross-functional engineering teams in the decision-making process.

Expected results

The work will eventually allow cost savings to be made in manufacturing through the minimisation of 'scrap', repair, concessions and the expensive re-processing of aluminium. Through looking at design in the light of residual stress, it is expected that the design work will enable engineers to optimise geometrical shapes and produce lighter components and hence lighter aircraft.



Solution – Process-based knowledge interacts with engineering tools enabling concurrent and multifunctional engineering compromise

Acronym:	COMPACT
Contract No.:	AST4-CT-2005-516078
Instrument:	Specific Targeted Research Project
Total Cost:	€5 329 473
EU Contribution:	€3 737 110
Starting Date:	To be established
Duration:	48 months
Website:	To be established
Coordinator:	Airbus UK Limited Manufacturing Engineering North Yorkon Building Golf Course Lane Filton GB-BS99 7AR Bristol

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Partners:	Airbus UK Ltd.	UK
	Bristol	UK
	Enabling Process Technologies	UK
	Universität Hannover	DE
	EADS Deutschland GmbH	DE
	University of Patras	EL
	Alenia Aeronautica S.p.A	IT
	Ultra RS	FR
	Institut National Polytechnique de Grenoble	FR
	University of Sheffield	UK

COMPROME

Monitoring, Optimisation and Control of Liquid Composite Moulding Processes

Background

The main limitation of the current Liquid Composite Moulding (LCM) manufacturing technologies in the fabrication of high quality, affordable and highly integrated aerospace structures lies in their inability to combine the available information (accurate simulations, measurements, experience and knowledge) dealing with the integrated process (resin flow and cure) in a global control system. The future developments require the refinement and integration of existing control approaches.

Project Objectives

The following principal and measurable project objectives are envisaged:

1. Development of a robust and tool-mounted integrated dielectric sensor cluster to follow the resin local flow (speed, direction) and cure progress accurately and reproducibly.
2. Development of an integrated process monitoring system with knowledge-based adaptable monitoring strategy and smart actuators, capable of reducing scrap components by 50%.
3. Development of intelligent and optimal on-line flow control validated on the mould filling of high temperature curing composite materials.
4. Integration of process (flow and cure) simulation tools to process monitoring systems and injection control equipment capable of reducing LCM product development costs by 40%.
5. Guidance of a composites production process through an optimal path for attainment of prescribed component properties, capable of reducing the overall process cycle by 50%.

Description of the work

The objectives will be achieved by integrating sensing principles and fabrication practices for compiling a prototype control system linked with industrial Resin Transfer Moulding injection control equipment. The project is organised into nine technical Work Packages:

Work Package 1: Development and testing of flow sensors for resin direction and speed measurement.

Work Package 2: Development and testing of integrated (flow and cure) sensors linked to material models for real-time evaluation of process parameters.

Work Package 3: Development of flow control system with identification parameters and process optimisation tools.

Work Package 4: Development of an integrated control system, utilising integrated sensors and smart monitoring strategies.

Work Package 5: Realisation of process control through the development and positioning of process actuators.

Work Package 6: Development of a global integrated process control system (IPC) for the global consideration of the component size.

Work Package 7: Implementating the developing technology step-by-step at lab-scale.

Work Package 8: Pilot-scale implementations at industrial users' manufacturing sites.

Work Package 9: Certification and exploitation issues.

Expected results

The project aims to develop a revolutionary control system applicable to the production of composite materials through a wide range of LCM methods. The COMPROME system utilises the dielectric signal for sensing resin flow and cure processes and consists of: (i) an integrated, durable and tool-mounted dielectric sensor; (ii) a modular monitoring system with embedded knowledge; (iii) a process control strategy; (iv) a global integrated process control (IPC) system; (v) the manufacturing aerospace components with cost-effectiveness and improved quality.

Acronym:	COMPROME	
Contract No.:	AST3-CT-2003-502900	
Instrument:	Specific Targeted Research Project	
Total Cost:	€3 265 323	
EU Contribution:	€1 822 860	
Starting date:	01/02/2004	
Duration:	36 months	
Website:	www.inasco.com/comprome.htm (to be mirrored into the site: www.comprome.net)	
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Partners:	Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
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	Polyworx VOF	NL
	ISOJET Equipements S.A.R.L.	FR
	Israel Aircraft Industries Ltd. (IAI)	IL
	Fundación INASMET	ES
	KEMA Nederland B.V.	NL
	National Technical University of Athens (NTUA)	EL
	Short Brothers plc	UK
	Kok & van Engelen Composite Structures B.V.	NL
	Laser Zentrum Hannover e.V.	DE

DEEPWELD
Detailed Multi-Physics Modelling of Friction Stir Welding

Background

DEEPWELD contributes to strengthening the competitiveness of the aeronautical industry in Europe. Friction stir welding (FSW) is a new technique that could revolutionise the way aircraft are built by replacing riveting with welding. The benefits of FSW include the ability to join materials that are difficult to fusion weld. It is a simple, robust process that involves no consumables. When handled properly, FSW results in a defect-free weld with superior properties. However, there is still a lack of knowledge on its applicability to aircraft structures. Although there is still a significant need for experiments, an advanced simulation tool is required to understand further the effect of the various welding parameters on the properties of the welds.

Project objectives

The overall goal of DEEPWELD is the development of a new multi-physics and multi-scale numerical tool for the accurate modelling of the friction stir welding process. This tool will help shorten the design cycle and decrease cost by reducing the number of experimental prototypes, replacing them with virtual prototypes. The DEEPWELD software will be equipped with a thermo-fluid module in order to simulate the important material flow around the FSW tool and an advanced metallurgy model in order to predict the evolution of micro-structures. Specifically instrumented experiments will be conducted in order to define accurate thermally varying friction laws, material constitutive laws and data in order to validate the new numerical tool.

Description of the work

The work is organised into four technical Work Packages:

Work Package 1: Detailed specifications of industrial target applications: The development of a numerical tool to simulate the FSW process, within the DEEPWELD consortium, will be carried out following specifications of the industrial end-users. This Work Package defines these specifications in terms of materials, applications, performance, software and experiments.

Work Package 2: Physics and Metallurgy: The first objective is to provide quantitative information to be introduced as input in the numerical codes to be developed in the DEEPWELD Project. The second objective is to provide sufficient information for a better understanding of the physical phenomena occurring during FSW. This is required to select appropriate modelling assumptions for the different models or modules (thermo-fluid, thermo-mechanical, and metallurgical).

Work Package 3: Multi-physics simulation tool development: Development of a general, numerical tool incorporating the coupling of the following fields: mechanical, thermal, metallurgy and flow calculation. The development of this general and multi-physics model will allow for predictive FSW simulations by: 1) eliminating the equivalent heat flux determined from experiments and replacing it by a thermo-fluid calculation, which will predict the amount of heat generated through plastic work and friction; 2) taking into account the changes in mechanical properties due to transformations in the micro-structure of the material.

Work Package 4: Validation and Applications: The objectives of this Work Package are: 1) an experimental validation campaign with a wide range of operating conditions; 2) a welding parameters optimisation in order to maximise the quality of the welds; 3) an application to the coupons' representative of industrial applications; 4) a structural response and certification to provide a quality criterion for the optimisation analysis.

Expected results

The expected result of DEEPWELD is a multi-physics and multi-scale simulation tool for the modelling of friction stir welding, able to achieve, among other things, accurate predictions of residual stresses, distortions, weld properties and tool loads.

FSW experiment at UCL

Acronym:	DEEPWELD
Contract No.:	AST4-CT-2005-516134
Instrument:	Specific Targeted Research Project
Total Cost:	€2 676 933
EU Contribution:	€1 552 466
Starting Date:	01/04/2005
Duration:	36 months
Website:	www.deepweld.org
Coordinator:	Centre de Recherche en Aéronautique, ASBL (CENAERO) Avenue Jean Mermoz 30 Bâtiment Mermoz 1 – 2ème étage BE-6041 Gosselies

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	SAMTECH S.A.	BE
	Centre Internacional de Mètodes Numèrics en Enginyeria (CIMNE)	ES
	Université Catholique de Louvain	BE
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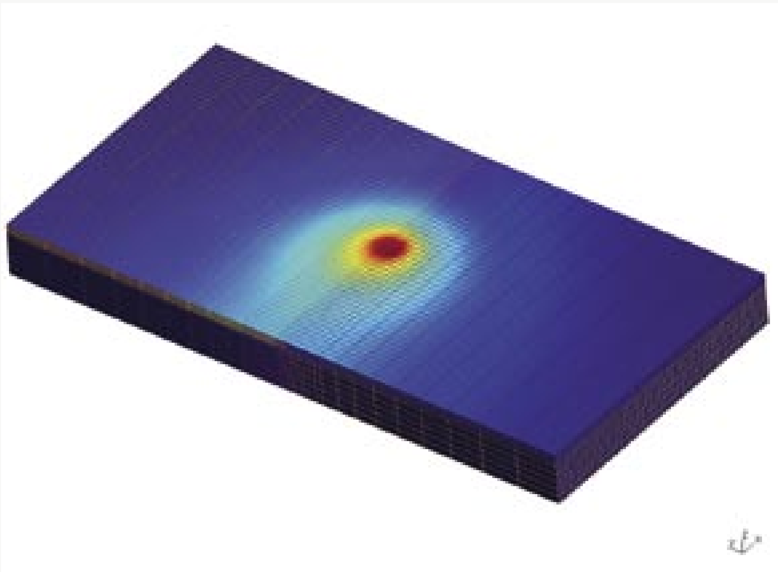
	The Queen's University of Belfast	UK
	EADS CCR	FR
	SONACA S.A.	BE
	Association pour la Recherche et le Développement des Méthodes et Processus Industriels	FR



Modelling of FSW

DINAMIT

Development and Innovation for Advanced ManufacturIng of Thermoplastics

Background

Today, high performance thermoplastic composite parts are mainly used in aeronautical structures. Compared to thermoset resin systems, they have many advantages: impact behaviour, fire resistance, low moisture absorption and welding capabilities. Despite this, thermoplastics are generally restricted to simple geometry parts and limited dimensions as the material and global production costs remain generally high.

Project Objectives

The main innovations resulting from this 36-month project will relate to the following objectives:

- The development of low-cost, high-performance thermoplastic composites applicable to aeronautical structural components based on:
  - blending of the thermoplastic structural matrix, the newly developed polyetherketoneketone (PEKK) structural resin, and new multi-axial thermoplastic fabrics.
- The development of new forming-consolidation processes for TP skins and substructures, among them:
  - automated lay-up and in situ consolidation processes for double curvature part applications, continuous and roll forming techniques, low-pressure injection process.
- The development of new welding processes based on:
  - laser technologies, and in situ welding processes.
- The creation of a cost optimisation tool, which will assess the developments of innovative TP materials and processes.

Description of the work

To achieve the general objectives of the programme, the work is divided into six technical Work Packages.

Materials:

After the elaboration of specifications for this new structural TP material, with a polyether ether ketone (PEEK) tape reference, the focus will be on the development of a ternary TP blend and its associated prepregs (tape and fabrics). The forming capabilities and mechanical properties of new TP multi-axial fabrics will be evaluated. Polyphenylene sulfide (PPS) behaviour in the melt state will be analysed for optimising the injection process. Processing routes for PEKK tapes will be compared.

Forming processes for Skin

A new automated lay-up technique associated with vacuum consolidation will be developed, and the in situ consolidation (ISC) process will be enhanced for double curvature part applications. Benchmarking tests will be supplied for comparison of different ISC processes. A specific diaphragm technique will be associated with the development of an IR heating model.

Forming processes for Substructure

A specific TP resin tranfer moulding process will be developed. A thermoset roll-forming machine will be upgraded for TP applications and a continuous forming technique will be employed for the manufacturing of contoured profiles.

Welding processes

Laser technologies will be investigated, either for the TP composite assembly, or for surface preparation before welding. An in situ welding technique will be developed, to be coupled to the ISC process.

Validation:

A reduced fuselage panel will be designed, and sized for validation of the automated lay up technology. Part of a TP fuselage frame will be designed for validation of the RTM process. Composite TP wing ribs will be manufactured with laser welded roll formed stiffeners. A TP landing gear door will be manufactured using in situ consolidation and welding processes.

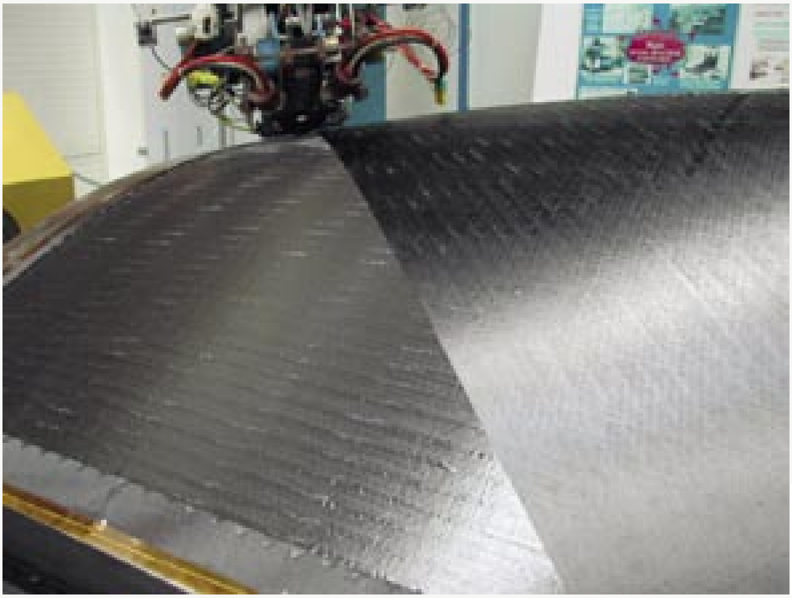
Cost effective analysis:

Finally, the real impact on cost reduction will be evaluated with a specific analytical tool.

Expected results

At the end of the project, it is hoped to obtain the following for application to aeronautics:

- a low-cost, high-performance TP material (a minimum of 20% cheaper compared to a reference material)
- available techniques for double curvature application (for example, an aircraft nose or fuselage)
- low-cost techniques for the manufacture of TP substructures to be welded to skins
- new techniques for welding high performance TP composites
- a management tool for cost-effective evaluation of new technologies, compared to reference cases.



From EADS/CCR: Automatic TP lay up on a double curvature part

Acronym:	DINAMIT
Contract No.:	AST3-CT-2003-502831
Instrument:	Specific Targeted Research Project
Total Cost:	€3 545 328
EU Contribution:	€2 026 492
Starting Date:	01/02/2004
Duration:	36 months
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Airbus España S.L.	ES
Airbus UK Ltd.	UK
Dassault Aviation S.A.	FR
Eurocopter S.A.S.	FR
University of Patras	EL
Fundación para la Investigación y Desarollo en Automoción	ES
Universität Bayreuth	DE
Advanced Composites and Machines GmbH	DE
Irish Composites (Ábhair Cumaisc Teoranta)	IE
Institut für Verbundwerkstoffe GmbH (IVW)	DE

ECOSHAPE

Economic Advanced Shaping Processes for Integral Structures

Background

A higher degree of integration during aircraft structure needs to be developed, which will save weight and reduce manufacturing costs, for example a reduction in assembly cost (riveting process) by laser welding (e.g. fuselage) or integral machining (e.g. wing structures). For such new concepts, the current manufacturing chain has to be altered, unifying the forming steps and shifting this new step further towards the end of production. This enables more processing, such as machining, pocketing, welding, to be done in a flat condition to achieve the full cost reduction potential.

Project objectives

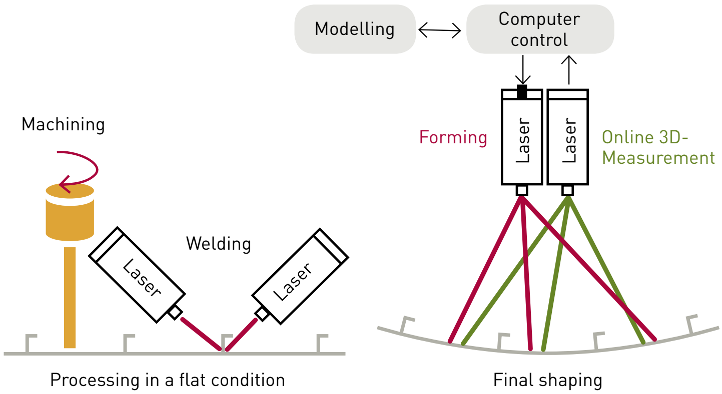
1. Forming stiffened structures to a single curvature of 1 250 to 3 000mm radii along stiffeners.
2. Forming bi-axially curved structures with an additional 10 000 mm radius across stiffeners.
3. Verification of estimated shell manufacturing cost reduction of 10% by more processing in a flat condition and a further 10% by avoidance of heavy and complex tooling.
4. Shell weight reduction of 10% using new alloys, which are less useful with conventional forming.

Description of the work

The objectives will be achieved by developing laser-forming methods to create 3D shapes from flat sheet material or even flat stiffened panels (Fig. 1 after conventional forming) using a controllable non-contact laser approach, eliminating expensive dies and forming tools. This requires the implementation of innovative techniques on a manufacturing scale and an understanding of the laser beam forming steps. To reach this goal, the project is organised into five technical Work Packages. The objective of Work Package 1 (Processes and materials basics) is to analyse basic influences of laser forming on the selected Al alloys. Work Package 2 (Process development and characterisation) is the central Work Package and includes process development and up-scaling, plus simulation implementation coming from Work Package 4. The objective of Work Package 3 (Biaxial curvature capability enhancement) is to cope with stiffened, bi-axially curved generic shapes. Work Package 4 (Simulation and verification) deals with process simulation. The main objective is to forecast the laser forming behaviour with a detailed 3D local model integrated in a 'less' detailed 2D global model, serving as a reference fast benchmark model to be used as an input to the control unit developed in Work Package 2. Work Package 5 (Economical evaluation and dissemination) has to verify the third main project objective by the economical evaluation of the laser-based forming processes developed during the project.

Expected results

The main aim is to develop laser-forming processes for integral fuselage and wing structures. Thus, relevant laser parameters with respect to minimum material degradation and maximum formable sheet thickness are evaluated. A simulation tool for the forming process is built up and integrated into a control system. The key to process control is to develop a predictive model to provide scanning strategies based on a required geometry. This system will include online 3D shape measurement to enable straight-line laser forming to the required final geometry.



Process principle and fuselage panel after conventional forming and LBW of stringers

Process principle and fuselage panel after conventional forming and LBW of stringers

Acronym:	ECOSHAPE
Contract No.:	AST3-CT-2003-502884
Instrument:	Specific Targeted Research Project
Total Cost:	€2 5011 716
EU Contribution:	€1 529 150
Starting date:	01/02/2004
Duration:	36 months
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	Alenia Aeronautica S.p.A.	IT
	Dassault Aviation S.A.	FR
	EADS CCR	FR
	Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
	Institute of Structures and Advanced Materials (ISTRAM)	EL
	Technische Universität München (TUM)	DE
	Instituto per le Ricerche di Tecnologia Meccanica e per l'Automazione S.p.A.	IT

IDEA

Integrated Design and Product Development for the Eco-efficient Production of Low-weight Aeroplane Equipment

Background

Regulatory efforts to lower the weight of aeroplanes, which in turn will decrease air and noise pollution, are forcing companies to develop new methods and processes to improve aircraft performance. The introduction of Mg-alloys in the aerospace industry will reduce aeroplane weight, improve noise damping and reduce fuel consumption. Alloys suitable for the aerospace industry must combine a high performance in mechanical properties with corrosion resistance. At present, there is a need to develop Mg-alloys to fulfil these requirements.

Project objectives

- To develop up to seven new Mg-alloys, which meet the end-users' requirements regarding corrosion resistance, mechanical properties, strength, fatigue and coatability. A maximum of three will be selected, from which prototypes and demonstrators will be developed.
- To optimise processes for sand and investment casting, gravity die-casting, high-pressure die-casting and special casting processes, enabling the production of non-structural, semi-structural and structural castings for aeroplanes, fulfilling end-user requirements.
- To develop simulation tools for the determination of local mechanical properties of magnesium castings and virtual standard tests (e.g. impact tests) of cast magnesium components.
- To prepare a design manual for cast magnesium components.
- To produce highly integrated demonstrator castings, which are approximately 30% lighter than the same components in their current design.

Description of the work

The work plan is split into two main phases, the Development Phase and the Application Phase. The Development Phase includes experimental work as well as casting process optimisation. Up to seven new Mg-alloys will be developed and will undergo intensive testing regarding properties like strength and fatigue as well as corrosion properties. New coatings for Mg-components will be developed, and reference castings will be selected and produced using commercial Mg-alloys. These castings will be analysed with respect to mechanical properties. In parallel, virtual tools for predicting local mechanical properties will be developed. This phase will end with the selection of the three most suitable new alloys for use in the Application Phase. In this second phase, the reference castings will be cast from the new alloys and undergo the same tests as in the first phase, which allows direct comparison of properties. Based on the test results, alloys and castings will be further optimised. Finally, the castings will undergo all the full-scale testing procedures usually carried out by aircraft manufacturers. The project's findings, as well as design rules and aviation standards, will be compiled in a design manual for aviation designers. A magnesium process and simulation database will collect all up-to-date information on magnesium casting.

Expected Results

The expected deliverables are:

1. New Mg-casting alloys, which fulfil the requirements of aviation industry regarding mechanical properties.
2. Virtual tools to enable the prediction of local mechanical properties of Mg-castings allowing their efficient optimisation.
3. A design manual guiding aviation designers safely when choosing Mg-components.
4. Demonstrator castings, which prove the suitability of Mg-castings for aviation applications.

Acronym:	IDEA
Contract No.:	AST3-CT-2003-503826
Instrument:	Specific Targeted Research Project
Total Cost:	€4 874 149
EU Contribution:	€2 892 421
Starting Date:	01/01/2004
Duration:	36 months
Website:	http://idea-fp6.net
Coordinator:	RWP Gesellschaft beratender Ingenieure für Berechnung und rechnergestützte Simulation GmbH Am Münsterwald 11, DE-52159 Roetgen
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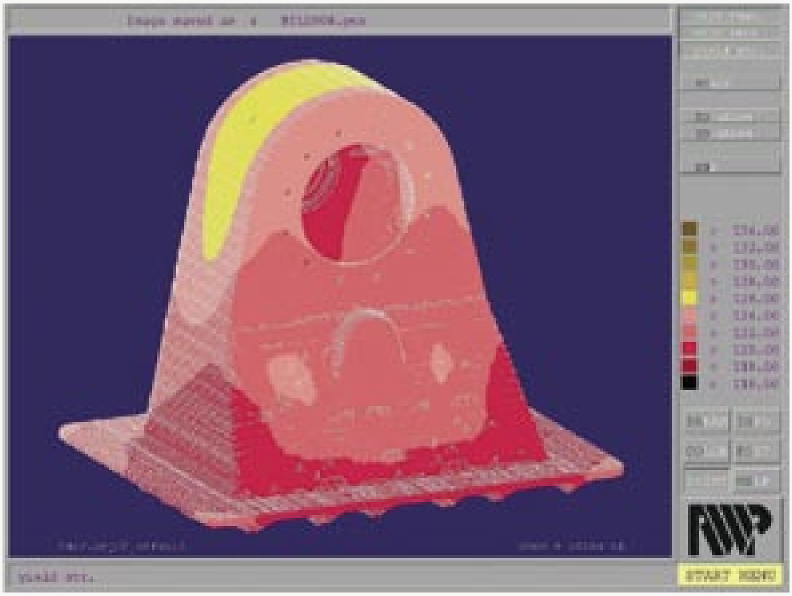
Israel Aircraft Industries Ltd. (IAI)	IL
Specialvalimo J. Pap OY	FI
Technical Research Centre of Finland (VTT)	FI
Kern GmbH	DE
Institut für Fertigungstechnik im Automobilbau GmbH (INFERTA)	DE
Slovenian Tool and Die Development Centre (TECOS)	SL
Fémalk RT Aluminium Die Casting Foundry Ltd.	HU
Université Henri Poincaré Nancy I	FR
Mondragon Goi Eskola Politeknikoa S.Coop.	ES
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	DE
Stone Foundries Ltd.	UK



IPROMES

Using Image Processing as a Metrological Solution

Background

The importance of metrological controls is increasing in the engineering industry, and particularly in aeronautics, due to the high measurement precision and quality requirements. This important operation varies from an average of 1 to 15% of the aeronautics total production time, depending on the type of produced parts or assembly. This is considerable for a sector where the production time is very high. Unfortunately, in order to reach the high level of quality, performance and safety needs, European aircraft industries have been obliged to invest in expensive and specific solutions as the dimensional precision and the positioning issues are critical.

Project objectives

This project aims to use photogrammetry and image processing techniques to perform the 'in-process' positioning during the assembly phase and to complete the final measurement control (quality control, maintenance) of aircraft parts afterwards. This project will use optical sensors (cameras) instead of the traditional gauges in order to automatically access geometrical data of parts and structures to be controlled, and then to proceed with three-dimensional measurements. With this optical solution, the manufacturing of the frame will be simplified. Thanks to the photogrammetry technique, the measurements will be calculated in real time with instant feedback from the cameras. Implementing a non-contact measurement system will allow drastic reduction of the control duration and standardisation of the control tools.

Description of the work

The innovative solution is based on photogrammetric and image processing techniques. Simultaneously, it offers a high precision, resulting from the use of photogrammetric techniques, and rapidity and ease-of-use, resulting from the use of automatic image processing. With an image processing-based technology, the images can be stored and thus it remains possible, months or years later, to proceed with a complementary measurement of specific characteristics of the part under scrutiny. This is very useful in terms of traceability. Secondly, a simultaneous measurement system can be used to assist the operator in positioning parts during the assembly process. The measurement system is thus not only useful in control operation but effectively becomes an assembly process tool. Thanks to the optical solution, an innovative framing concept will be set up, so no positioning issue will be required. As the frame will only support the sensors, it will be simplified compared to the current ones. This improvement will lead to proposals for adoption of a 'universal frame'. Indeed, with such a measurement system it becomes possible to create multi-purpose and versatile frames, which can be used for different types of aircraft (for example Airbus A320/A340).

Expected results

This project will lead to the following results:

New image processing algorithms, new optical sensors meeting the requirements of the aeronautical sector, a 'steps and gaps' optical measurement system for aeronautics, a flexible frame prototype equipped with optical sensors, and new assembly concepts.

Acronym:	IPROMES
Contract No.:	AST3-CT-2004-502905
Instrument:	Specific Targeted Research Project
Total Cost:	€3 216 685
EU contribution:	€1 809 104
Starting Date:	01/01/04
Duration:	36 months
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	Technische Universität Graz	AT
	COORD 3 S.p.A.	IT
	ESIC - SN S.A.R.L.	FR
	Israel Aircraft Industries Ltd. (IAI)	IL
	SEROMA	FR
	Techspace Aero S.A.	FR
	METROSTAFF s.r.l.	IT

ITOOL

Integrated Tool for Simulation of Textile Composites

Background

Textile preforming of composites offers the potential of significant cost savings in comparison to prepreg (pre-impregnated) tape layering. To enable engineers to make use of dry fibre textiles, reliable simulation tools and design principles are needed. In contrast to conventional, unidirectional reinforced composites, textile reinforcement results in 3D fibre architectures so that standard analysis procedures, like 2D rules of mixture and laminate theory, are no longer valid. It is also important to consider the manufacturing processes since they have a strong influence on the textile properties.

Project objectives

The technical approach of ITOOL is a simulation along the process line in a virtual manufacturing chain, which incorporates the preform manufacturing, draping and impregnation process followed by the external loading of the finished component.

The scientific objective of ITOOL is to close the gap between missing knowledge and proved advantages of dry fibre textiles by developing an adequate integrated simulation tool for textile preforming technologies including braiding, advanced engineering textiles, weaving and stitching. Reliable simulation tools and design methods provide the enabling prerequisites for an increased use of these materials in aerospace and other industries.

From the technical point of view, a special focus will be on 3D reinforcements by the use of structural stitching to improve mechanical properties of composites in the thickness direction (damage tolerance +80%, fracture toughness +75%, weight specific energy absorption +75%).

By achieving the objectives mentioned above, ITOOL can provide the basis of a standard for the design, analysis and testing of textile preformed composites in Europe.

Description of the Work

As there are already stand-alone solutions for several parts of the simulation in use, the approach of ITOOL is mainly the linking and integration of these tools to ensure a fluid interaction and data interchange. This approach will enable a flexible and adaptable solution, which may be extended by the user to include alternative technologies.

The materials used in the project, especially the ones that will be used for a set of validation examples, will be characterised. The relevant data will be stored in a database structure allowing the user to access the properties they will need.

The mechanical behaviour will be analysed on three different approximation levels called 3M (micro / meso / macro) mechanics:

- on the microscale, the different constituents are always modelled separately
- on the mesoscale, fibre and matrix properties are homogenized locally
- on a macro level, the micro or mesoscale models are homogenised in a coarser way to lower the computational effort.

The processes used in production and handling of textile preforms will be evaluated and appropriate models will be developed to predict their influence on the properties of the preform materials. The draping and infiltration behaviour of textile preforms will be the focus of this subtask.

Static stress and failure models will be developed to predict macroscopic structural deformation, stress and failure of textile-reinforced structures. Global analysis methods, which compute structural behaviour under external loads, will be provided. The developed tools will address static stress, quasi-static failure, crash and dynamic impact computations.

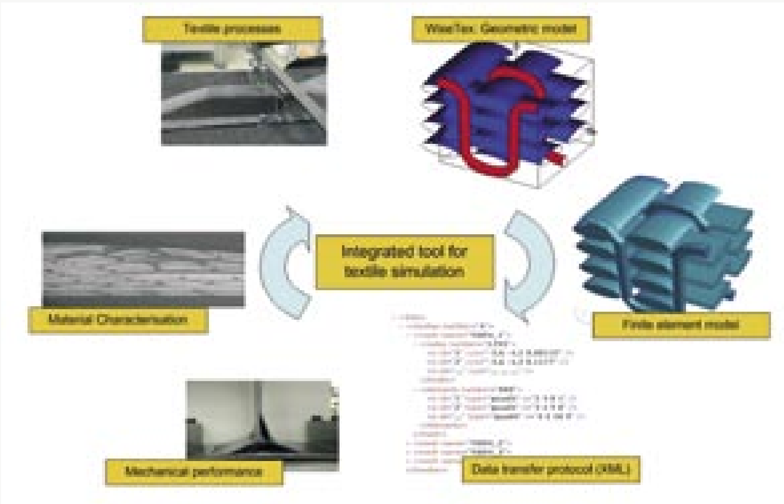
The proof for this integration concept will be performed for different application fields of textile-preformed composites in aerospace: typical stiffened skin sections, integral joining technologies and a braided propeller fan. The evaluation also includes the interface and the related flow of data as a measure of the quality of results in comparison to tests.

In parallel to the development of the integrated simulation tool, the second aspect of the project is to build up physical understanding of the behahiour of textile preformed composites to increase their usage. Therefore, design rules for the use of dry fibre textiles will be extracted and made easily available for the design engineer as a guideline.

Expected Results

To fulfil the objectives within a limited time (and cost) scale, the linking and integration of different stand-alone solutions in the tool chain is proposed, thus creating an open flexible interface for fluent data exchange and communication.

The main benefit is to users of textile composites. ITOOL can set up a standard for testing, modelling and simulation, thus responding to market demands. A further impact of the enhanced simulation capabilities will be a reduction of at least 20% in necessary testing effort, as well as a lead-time reduction of more than 15%.



Acronym:	ITOOL
Contract No.:	AST4-CT-2005-516146
Instrument:	Specific Targeted Research Project
Total Cost:	€3 754 097
EU Contribution:	€2 619 913
Starting Date:	01/03/2005
Duration:	36 months
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	EADS CCR	FR
	ESI Group	FR
	Universität Stuttgart	DE
	Rheinisch-Westfälische Technische Hochschule Aachen	DE
	Katholieke Universiteit Leuven	BE
	Institut National des Sciences Appliquées de Lyon	FR
	Sistemas y Procesos Avanzados S.L.	ES
	Fundación Empresa Universidad de Zaragoza	ES

MACHERENA

New Tools and Processes for Improving Machining of Heat-Resistant Alloys Used in Aerospace Applications

Background

A286 and INCONEL 718 are materials that, due to their high Ni content and heat resistance, are very difficult to machine, and this results in the high cost of parts manufactured with these materials. The results of this process will open the way for more cost-effective production processes for aerospace parts. TiAl is a good candidate material for future aerospace applications, due to its low weight and good resistance at high temperatures. However, its low machinability (10% of that of Ni alloys) makes the production costs very high for many applications. A reduction of the TiAl intermetallic machining cost will open up the possibility of the design and application of new parts.

Project objectives

The partners of this project want to develop new machining tools, nanocomposite coatings and machining processes to address the following industrial objectives:

- tool life increase
- reduction of production costs
- increase of machining productivity (more advanced cutting parameters)
- optimal coolant utilisation
- improvement of finishing quality.

All these objectives are related to the machining processes of heat resistant alloys used in aerospace applications. The selection of materials will be focused on the following:

- Fe-Ni alloys: A286
- Ni based materials: INCONEL 718, IN 100
- Intermetallics: g-TiAl

Description of the work

The project objectives will be addressed by the development of new tool geometries, hard and low-friction nanocomposite coatings produced by physical vapour deposition (PVD) methods and new machining processes (high pressure cooling). At a first stage, the machining shops and end-users will collaborate with the R&D centres, and the tools and coating producers, in defining which machining processes and tools will be used to evaluate the new developments. Three demonstrators (one from each material family) will be defined, as they will be used at the end of the project to evaluate the performance of the new tools, coatings and machining processes. With the defined characteristics of the tools and their problems, the possibility of addressing new tool designs will be evaluated, taking into account that these tools will be coated.

New nanocomposite coatings will be developed, considering the special requirements specified by the end-users and machining shops. There will be mainly three lines of the research. The system AlTiSiN will be optimised to cope with the demands of hardness and friction. An approach will also be made to other compositions, where the Ti will be substituted by other elements that have shown better friction behaviour, or where low-friction phases are added.

The developed nanocomposite coatings will be tested in the laboratory facilities. The coatings will be applied on standard and newly developed tools, and the machining parameters that show the best behaviour of the tool from an efficiency point of view will be investigated. The tools will also be analysed to determine the failure modes, and this analysis will act as input for coating optimisation. At this point, optical microscopes, scanning electron microscopes (SEM), profilometry and roughness measurement devices, and metallography facilities will be used. Furthermore, advanced machining processes, like high pressure cooling machining, will be tested on the coated tools to increase even more efficiency (tool lifetime, machining speed, etc). The tests will start with the Fe-Ni and the Ni alloys, and will further address the machining process for the γ-TiAl intermetallic.

The third leg of the testing table will consist of real production tests performed at the machining shops. The results of these tests will provide feedback and help the optimisation of both coatings and machining parameters. The results will be evaluated in the production of real parts (demonstrators), one of each from the material families selected.

Expected results

- Reduction by more than 50% of the process costs where the tools have been coated and new cutting technologies have been applied.
- Increase by more than 100% in machining efficiency of milling Fe-Ni, Ni alloys and γ-TiAl
- Increase by more than 100% in machining efficiency of turning Fe-Ni, Ni alloys and γ-TiAl
- Increase by more than 50% in machining efficiency of drilling Fe-Ni, Ni alloys and γ-TiAl

The term 'machining efficiency' is directly related to production costs, and takes into account parameters such as tool life, machining speed and tool cost.

Acronym:	MACHERENA
Contract No.:	AST3-CT-2003-502741
Instrument:	Specific Targeted Research Project
Total Cost:	€4 164 285
EU Contribution:	€2 310 522
Starting Date:	01/01/2004
Duration:	36 months
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Partners:	Mecanizados Escribano S.L.	ES
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	Technische Universität München (TUM)	DE
	SHM Ltd.	CZ
	UNIMERCO A/S	DK
	ETS Echevarria et Fils	FR
	GEYCA Gestión y Calidad S.L.	ES
	Compañia Española de Sistemas Aeronáuticos S.A. (CESA)	ES
	Volvo Aero Norge A.S.	NO

TOPPCOAT

Towards Design and Processing of Advanced, Competitive Thermal Barrier Coating Systems

Background

The target is to develop more reliable, less expensive Thermal Barrier Coatings (TBCs) with increased lifetimes and improved temperature capability. The top coat of TBC systems consists of a low thermal conductivity material such as yttria stabilised zirconia (YSZ). This can be thermally sprayed by means of air plasma spraying (APS) or deposited by (more expensive) electron beam physical vapour deposition (EB-PVD). The PVD process leads to a columnar microstructure giving the coating a high strain tolerance, and a greater lifetime and reliability than plasma-sprayed TBC systems.

Project objectives

Due to their higher strain tolerance, segmented or columnar structures within the TBC, in combination with excellent bonding, are essential to improving the durability of TBC systems. The investigation of these structures constitutes the first objective. The developed segmented APS coatings will be compared with standard EB-PVD coatings. It is anticipated that this route will lead to TBC systems with a performance close to that of EB-PVD but at a fraction of the cost.

Since the project is aimed towards the next generation of TBC systems, the second objective will be the investigation of new technologies with the potential to produce highly strain-tolerant coatings in a cost-effective way. These are thin film/low-pressure plasma spraying (TF-LPPS), plasma-enhanced chemical vapour deposition (PE-CVD), nano-phase suspension plasma spraying and hollow cathode gas sputtering PVD (GS-PVD).

A major contribution will be the substitution of the expensive EB-PVD process for the coating of aero gas turbine blades and vanes by the APS process.

Description of the work

Work Package 1, entitled 'Technical specifications, procurement of substrates, bondcoat and standard topcoat materials', will additionally supply the complete reference TBC system produced by the PVD technique.

Beside standard spray-dried powders, new powders will be developed in Work Package 2, 'Optimisation of starting powders and materials', in order to decide the powder type most suitable for the generation of high segmentation densities.

Different structures for the substrate interface will be studied in Work Package 3, 'Interface design', to improve the bonding between ceramic coating and substrate.

In Work Package 4, 'Advanced technology for manufacture of strain tolerant coatings', coatings with strain-tolerant microstructures will be developed, based on the spraying parameters leading to relatively thick segmented coatings. Additionally, four new emerging technologies, although a long way from being applied in gas turbine industry for TBC coatings, will be considered: Low Pressure Plasma Spraying Thin Film technology (LPPS TF), Suspension Plasma Spraying of nanop- powders, High Speed Physical Vapour Deposition (HS-PVD) and Microwave Plasma Enhanced Chemical Vapour Deposition (PE-CVD).

The coating evaluation regarding thermal cycling and the formation of oxide scales on the bondcoat is carried out in Work Package 5, 'Screening of key properties and full characterisation'. The performance of the coating will be compared to those of standard PVD coatings and the comparison used as the basis of the mid-term assessment review.

In Work Package 6, 'Transfer and application of technology' all partners will get full access to the developed technology. An analysis of the cost reduction due to the new APS coatings will be performed. Finally, three components of gas turbines, parts of the combustion chamber, vanes, blades and plate cooling rear will be coated for testing in the final work-package.

Work Package 7, 'Final evaluation of the advanced TBC systems under close-to-service conditions', will also investigate the density of delaminations by means of non-destructive testing as infrared termography. A qualification test for the introduction of the new coatings on blades of a stationary gas turbine will be performed.

Expected results

The main achievements will be the lifetime extension of conventional TBCs through advanced strain tolerance and high density of segmentation cracks, and the development of new techniques for the next generation of TBCs.

The substitution of the expensive EB-PVD technique for coating blades will result in a 1.5% reduction of engine costs. Further achievements will include maintenance costs reduced by up to 20%, due to the doubling of coating lifetimes. Finally, an increase in operating temperature of 20-30 K for components coated in the past with APS will reduce fuel consumption by about 1%.

Acronym:	TOPPCOAT
Proposal No.:	AST4-CT-2005-516149
Instrument:	Specific Targeted Research Project
Total cost:	€3 942 300
EU funding:	€2 125 950
Starting date:	01/02/2006
Duration:	48 months
Coordinator:	Forschungszentrum Jülich GmbH Institute for Materials and Processes in Energy Systems IWV-1 Leo-Brandt-Straße DE-52428 Jülich
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Partners:

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AVIO S.p.A.	IT
Centro Elettrotecnico Sperimentale Italiano 'Giancino Motta' S.p.A. (CESI)	IT
Forschungszentrum Jülich GmbH (FZJ)	DE
Högskolan i Trollhättan/Uddevalla (HTU)	SE
National Physical Laboratory (NPL)	UK
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Rolls-Royce Deutschland Ltd. & Co. KG	DE
SAFRAN S.A.	FR
Southside Thermal Sciences Ltd.	UK
Sulzer Metco AG	CH
Treibacher Industrie AG	AT
Turbocoating S.p.A.	IT
Volvo Aero Corporation AB	SE

VERDI

Virtual Engineering for Robust Manufacturing with Design Integration

Background

The VERDI project will contribute to winning global leadership for European aeronautics by developing a new generation of engineering technologies, which allows for complete virtual manufacturing of structural aero engine components, integrated into the design process and manufacturing. This enables robust manufacturing methods to be designed into the component, minimising cost and lead-time due to physical trials and long feedback times. The developed technology will trigger a quantum step in cost reduction for design or re-design of new or existing aero engine components.

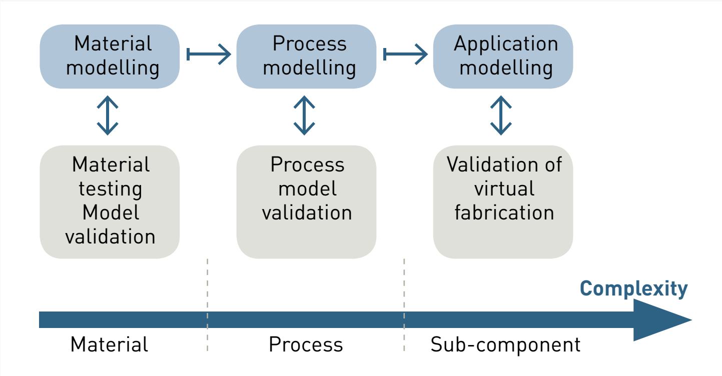
Project objectives

- Development of multi-scale process simulation tools for metal deposition, welding, heat treatment, surface strain hardening and machining.
- Integration of process simulation tools.
- Integration of process simulation and design.
- Integration of process simulation and manufacturing.
- Implementation of manufacturing simulation in Europe's aero engine industry.

Description of the work

VERDI is a research project with strong focus on development and validation of the numerical framework that is the foundation of virtual fabrication. The project structure comprises six Work Packages, including one devoted to project management. VERDI is planned to follow both the logical order for the development of manufacturing process simulation tools and the structure for applying virtual manufacturing within an engine development project. The process modelling tools are built up from fundamental material modelling, manufacturing process modelling and integration of the individual models to enable complete virtual fabrication of a component.

Support from design and manufacturing is continually available during the entire



project to ensure the desired integration. All models and tools will be validated at each appropriate level in order to ensure a robust development process with high quality input results to the next level.

Expected results

Two sub-components will be manufactured, based solely on virtual models. They will represent a 'cold' front engine fan/compressor structure in titanium and a 'hot' rear-engine turbine structure in a nickel-based alloy. The result will be evaluated and the concept of virtual fabrication will be validated against the manufactured hardware. VERDI will validate the methods and tools developed within a concurrent environment for design and manufacture of 'right first time' gas turbine structures, with 5% reduced cost and 25% lead-time for an aero engine development project.

Acronym:	VERDI
Contract No.:	AST4-CT-2005-516046
Instrument:	Specific Targeted Research Project
Total Cost:	€6 389 035
EU Contribution:	€4 498 319
Starting date:	01/09/2005
Duration:	48 months
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Partners:		
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	Luleå tekniska universitet (LTU)	SE
	Högskolan i Trollhättan/Uddevalla (HTU)	SE
	Rolls-Royce plc	UK
	University of Nottingham	UK
	MTU Aero Engines GmbH	DE
	Rheinisch-Westfälische Technische Hochschule Aachen	DE
	Universität Karlsruhe (Technische Hochschule)	DE
	Industria de Turbo Propulsores S.A.	ES
	Associación de Investigación y Cooperación Industrial de Andalucía	ES
	Centre Internacional de Mètodes Numèrics en Enginyeria (CIMNE)	ES
	Techspace Aero S.A.	BE
	Centre de Recherche en Aéronautique A.S.B.L. (CENAERO)	BE
	AVIO S.p.A.	IT
	Politecnico di Torino	IT
	Engin Soft Tecnologie per l'Ottimizzazione s.r.l. (ESTECO)	IT

WEL-AIR

Development of Short Distance Welding Concepts for Airframes

Background

The development of welded structures has been identified by airframe manufacturers as potentially leading to lighter airframes and low-cost manufacturing. Weight and cost efficiency will be obtained on the 'Integral Structure' or 'Rivet-Free' Al-alloy airframes through the use of advanced welding technologies, such as laser beam (LBW) and friction stir welding (FSW), and the introduction of new aluminium alloys with improved performances. A318 and A380 aircraft are already flying having had their fuselage panels manufactured with large distance LBW skin-stringer joints. Now, there is a need to extend the current level of technology to 'more critical and difficult-to-join' sections of metallic airframes with the replacement of conventional riveted sub-sections with a short distance welded integral structure, which exhibits lightweight and damage-tolerant features.

Project objectives

Within this context, the main scientific and technological objectives of the project are:

- To optimise and validate the most suitable short distance laser beam welding process parameters for various Al-alloy combinations for the joining of stiffener/clip-skin connections of airframes by understanding and controlling the basic mechanisms of hot tearing, crack initiation and crack growth at the run-in/out location.
- To develop a short distance friction stir welding process for suitable joints and non-laser weldable alloys and gain knowledge about these new applications.
- To develop repair schemes of short distance welds and define allowable damages to minimise the maintenance and operational costs.
- To conduct systematic damage tolerance analysis on short distance welded coupons to establish the mechanisms of initiation and spread of the damage at or around the run-outs.
- To establish structural safety provisions for the case of ageing and corrosion damage (long-term behaviour/durability) by understanding the micro-mechanism/metallurgy of the damage at the short distance welds.

Description of the work

The technical approach of the project follows a 'develop, test, check, make recommendations, validate on components' pattern, split into five technical Work Packages. The first three Work Packages deal with the establishment of databases relative to potential techniques for improving the fatigue and damage tolerance behaviour of short distance welds, using both friction stir welding and laser beam welding for stiffener-skin connections.

The first Work Package aims to develop laser beam and friction stir welding procedures for control of the run-ins and run-outs of the welds, and to propose some repair techniques for non-allowable welding defects. Firstly, an overview related to cracking occurrence in laser beam welding and industrial conditions, previously tested non-allowable welding defects, run-out control and repair procedures will be presented by aircraft manufacturers with a background in this field (AIRBUS, EADS). Taking this overview into account, various run-in/out control and repair procedures will be tested by the LBW welder partners (EADS, GKSS, ALENIA, Institut de Soudure) using various laser beam welding equipments (YAG technology, various powers, fibre diameter, focal length), clamping equipments and various filler wires. The validation of the improved procedures will be tested in industrial conditions. Concerning friction stir welding, the retractable pin tool technique for control of the run-outs of the short distance stiffener-skin joints and potential repair technique of the FSW hole located at the end of the welds will be developed (EADS CRC, Institut de Soudure, GKSS).

The second Work Package deals with design aspects of the stiffener-skin connection and especially the evaluation of new generation aluminium alloys with improved mechanical performances (fatigue and damage tolerance) and/or better weldability or hot cracking resistance.

Damage tolerance (fatigue and fracture) and durability of the laser beam and friction stir welded joints for various welded configurations are the main topics of the third Work Package (including alloys, processes, joint configuration, thermal temper and surface treatment).

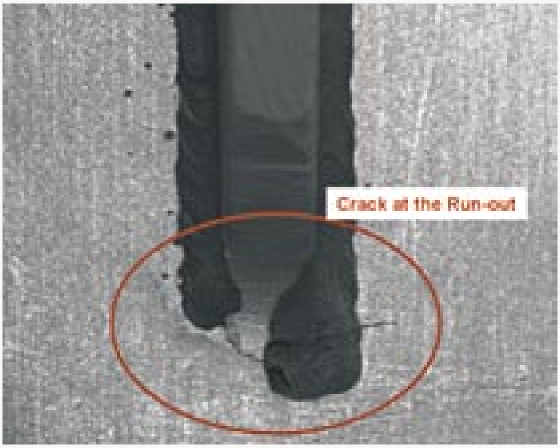
Data bases will be obtained from the three first work packages and the most relevant welding concepts for improved stiffened structures will be proposed.

The last two Work Packages deal with concept validation on technological specimens, especially flat and curved specimens, with welded stringers only or welded bi-directional stiffening. In the fourth Work Package, the technological specimens will be defined and manufactured and in the fifth, the specimens will be tested and the results analysed.

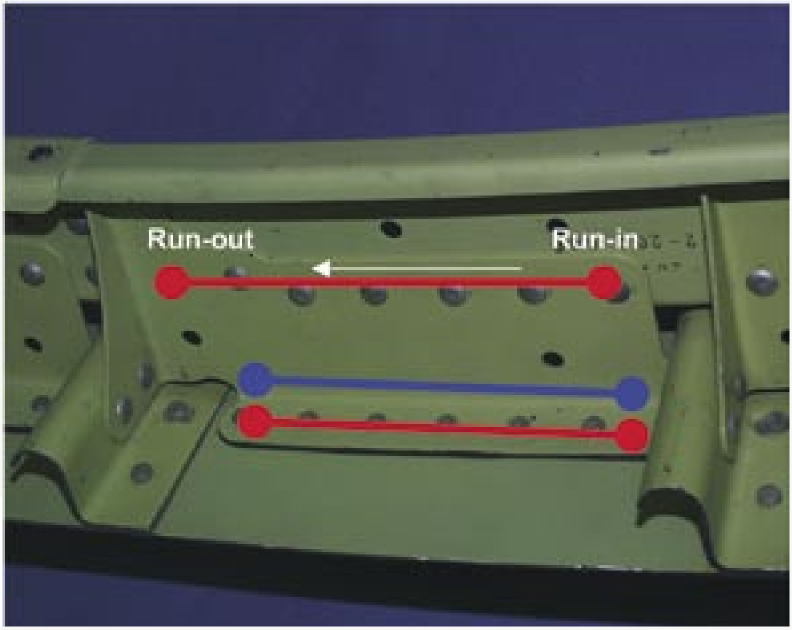
Expected results

The WEL-AIR project will provide:

- A complete database, which is related to the manufacture and performance of innovative and improved welding concepts for stiffener-clip-skin connection including new joint design, laser beam welding and friction stir welding procedures and a selection of new high performance light alloys for both stiffeners and skin.
- Run-in/out control and repair procedures for both laser beam welding and friction stir welding.
- Recommendations on optimum material conditions (temper and surface) prior to welding to optimise the post-welding behaviour.
- Damage tolerance data and fundamental rules for the integration of new welding on aircraft sections that are more critical.



Development of
Short Distance
WELding concepts for
AIRframes



Development of
Short Distance
WELding concepts for
AIRframes

Acronym:	WEL-AIR
Contract No.:	AST3-CT-2003-502832
Instrument:	Specific Targeted Research Project
Total cost:	€5 035 405
EC Contribution:	€2 692 000
Starting date:	01/01/2004
Duration:	36 months
Coordinator:	EADS Corporate Research Centre Materials and Processes Department 12 Rue Pasteur BP76 FR-92152 Suresnes Cedex
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Partners:		
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	Airbus Deutschland GmbH	DE
	Airbus France S.A.S.	FR
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	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Pechiney Centre de Recherche de Voreppe	FR
	Société Anonyme Belge de Constructions Aéronautiques (SABCA)	BE
	Dassault Aviation S.A.	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Alenia Aeronautica S.p.A.	IT
	Institute of Structures and Advanced Materials (ISTRAM)	EL
	Piaggio Aero Industries S.p.A.	IT
	Institut de Soudure	FR

LAPCAT

Long-Term Advanced Propulsion Concepts and Technologies

Background

To reduce long-distance flights, for example from Brussels to Sydney, to less than two to four hours, advanced propulsion concepts and technologies need to be identified and assessed. This requires a new flight regime with Mach numbers ranging from four to eight. At these high speeds, classical turbo-jet engines need to be replaced by advanced air-breathing engines.

Project Objectives

Two major directions on a conceptual and technological level are considered: ram-compression and active compression. The latter has an upper Mach number limitation but can accelerate a vehicle up to its cruise speed. Ram-compression engines need an additional propulsion system to achieve their minimum working speed. The key objectives are the definition and evaluation of:

- different propulsion cycles and concepts for high-speed flight at Mach 4 to 8 in terms of turbine-based (TBCC: fig. 1) and rocket-based combined cycles (RBCC: fig. 2)
- critical technologies for integrated engine/aircraft performance, mass-efficient turbines and heat exchangers, high-pressure and supersonic combustion experiments and modelling.

Description of Work

A sound technological basis for the industrial introduction of innovative advanced propulsion concepts in the long term (20-25 years) will be provided, defining the most critical RTD-building blocks by developing and applying dedicated analytical, numerical and experimental tools along the following road map:

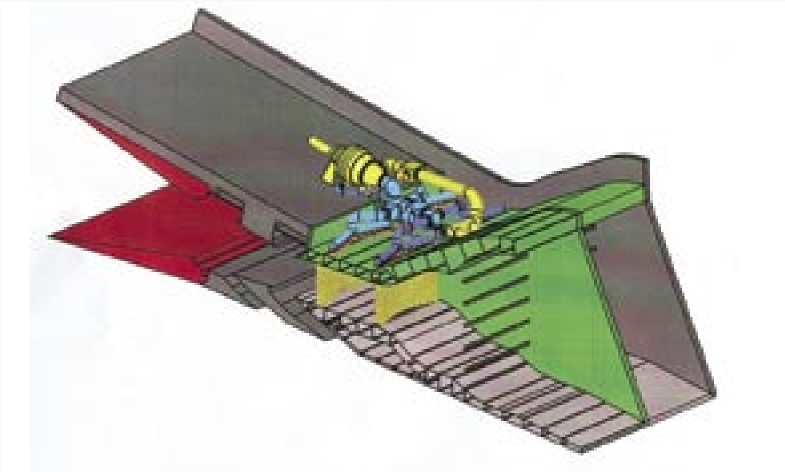
- two air-breathing engines for a commonly agreed reference vehicle(s) and trajectory point(s)
- dedicated combustion experiments on supersonic and high-pressure combustion, including potential fuels and interaction with flow-field turbulence
- modelling and validation of combustion physics on the basis of chemical kinetics and fuel spray vaporisation models and turbulence affecting the combustion
- aerodynamic experiments for major engine components (intakes, nozzles, full engines), interaction of vehicle and propulsion aerodynamics resulting in a database
- evaluation and validation of advanced turbulence models to evaluate unsteady, separated flow regimes and to develop transition models based on intermittency-related parameters
- performance prediction of contra-rotating turbines and light cryogenic fuel heat exchangers.

Expected Results

The project duration of 36 months will result in:

- a definition of requirements and operational conditions on a system level for high-speed flight
- dedicated, experimental databases on supersonic and high-pressure combustion and flow phenomena specific to high-speed aerodynamics
- setting-up and validating physical models integrated into numerical simulation tools on supersonic and high-pressure combustion, turbulence and transition
- feasibility of weight performance of turbine and heat exchanger components.

Turbine Based Combined Cycle
Rocket Based Combined Cycle



Two Combined Cycle engine concepts that will be investigated for high speed cruise applications in LAPCAT.

Acronym:	LAPCAT
Contract No.:	AST4-CT-2005-012282
Instrument:	Specific Targeted Research Project
Total cost:	€7 092 822
EU Contribution:	€3 999 778
Starting Date:	26/04/2005
Duration:	36 months
Coordinator:	European Space Agency (ESA) European Space Research and Technology Centre (ESTEC) Keplerlaan 1, NL-2200 AG Noordwijk
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Partners:	SAFRAN S.A.	FR
	Von Karman Institute for Fluid Dynamics (VKI)	BE
	EADS – Space Transportation GmbH	DE
	Centre de Recherche en Aéronautique A.S.B.L. (CENAERO)	BE
	Reaction Engines Ltd. (REL)	UK
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
	Universität Stuttgart	DE
	Università degli Studi di Roma “La Sapienza”	IT
	University of Southampton	UK
	University of Oxford	UK

NACRE
New Aircraft Concepts Research

Background

Over the past 50 years, the main driver for aircraft design has been to improve operational efficiency, particularly by reducing fuel consumption. Given that air traffic is predicted to more than double in the next 20 years and that both environmental and economic pressures will strongly increase, significant progress will need to be achieved in both improving the efficiency and minimising the environmental impact of aircraft.

This may not be achievable with today's configuration. In order to provide the step changes required, new aircraft concepts will need to be developed.

Project objectives

The NACRE Integrated Project aims at integrating and validating technologies that will enable new aircraft concepts to be assessed and potentially developed. As such, it will not concentrate on one specific aircraft concept, but is aimed at developing solutions at a generic aircraft component level (cabin, wing, power plant system, fuselage), which will enable the results to be applicable for a range of new aircraft concepts. For each of the major aircraft components, the multidisciplinary investigations will explore the different associated aspects of aerodynamics, materials, structure, engines and systems with the goal of setting the standards in future aircraft design, thus ensuring improved quality and affordability, whilst meeting the tightening environmental constraints (emission and noise), with a vision of global efficiency of the air transport system.

Description of the work

From 2005 to 2009, NACRE proposes to investigate the development of the concepts and technologies required for novel aircraft concepts at a generic aircraft component level: wing, fuselage and engine integration. NACRE will enable the necessary capabilities to be developed and assessed, through their integration and validation on a range of novel aircraft concepts: Low Noise Aircraft, Flying Wing, Low Cost Aircraft.

Thus, in order to explore the most relevant capabilities and meet the widest range of challenges, the NACRE project proposes to identify a set of concepts tailored to address specific subsets of design drivers:

- The Pro Green (PG) aircraft concepts, paying major emphasis on the reduction of environmental impact of air travel;
- The Payload Driven Aircraft (PDA) concepts, aiming at optimised payload and appreciable quality of future aircraft for the end users;
- The Simple Flying Bus (SFB), which puts the biggest emphasis on low manufacturing costs and minimum cost of ownership.

Irrespective of what final future product configurations might look like, these concepts will act as basic vectors, describing and stimulating the whole of future capability developments. More than the intrinsic value of any one concept, what is of importance is the consistent capability enhancement that they prepare.

The rationale is that each of these concepts will allow the exploration of alternative routes for the major aircraft components (fuselage, wing, engine integration) that are better suited to their specific targets and which would have been rejected in a balanced approach. The associated envelope of innovative designs (fuselage, wing, engine integration) and associated technologies will provide better answers to the full range of requirements, or expected ones. NACRE is therefore in essence a focused multidisciplinary approach.

The NACRE consortium is composed of 35 partners from 13 countries, including Russia, and will take full benefit of the preliminary activities initiated in Europe on novel aircraft concepts in the Fifth Framework programme projects ROSAS, VELA and NEFA.

Expected results

A set of unconventional aircraft concept configurations will be developed:
- Pro Green aircraft
- Payload Driven Aircraft
- Simple Flying Bus.

They will feature advanced components or systems i.e., wings, empennage, power plant installation, fuselage and cabin. These major aircraft components will undergo specific multidisciplinary exercises in order to develop the associated innovative capabilities (aerodynamics, acoustics, structure and systems).

Integration at overall aircraft level will be carried out in order to challenge the concepts' objectives.

Acronym:	NACRE	
Contract No.:	AIP4-CT-2005-516068	
Instrument:	Integrated Project	
Total Cost:	€30 345 991	
EU Contribution:	€16 909 656	
Starting Date:	01/04/2005	
Duration:	48 months	
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Partners:	Airbus France S.A.S.	FR
	Airbus Deutschland GmbH	DE
	Airbus España S.L.	ES

Airbus UK Ltd.	UK
Alenia Aeronautica S.p.A.	IT
Aircraft Research Association Ltd.	UK
Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
Dassault Aviation S.A.	FR
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
EADS Deutschland GmbH	DE
Swedish Defence Research Agency (FOI)	SE
AIRCELLE SAS	FR
IBK Ingenieurbüro Dr. Kretschmar	DE
Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
Instituto Nacional de Técnica Aeroespacial (INTA)	ES
Messier-Dowty Ltd.	UK
MTU Aero Engines GmbH	DE
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Projecto, Empreendimentos, Desenvolvimento e Equipamentos Cientificos de Engenharia (PEDECE)	PT
Piaggio Aero Industries S.p.A.	IT
Rolls-Royce Deutschland Ltd. & Co. KG	DE
Rolls-Royce plc	UK
SAFRAN S.A.	FR
Central Aerohydrodynamic Institute (TsAGI)	RU
Vyzkumny a Zkusebni Letecky Ustav, A.S. (VZLU)	CZ
Trinity College Dublin	IE
University of Greenwich	UK
Technische Universität München (TUM)	DE
Kungliga Tekniska Högskolan (KTH)	SE
Universität Stuttgart	DE
Politechnika Warszawska (Warsaw University of Technology)	PL
ARTTIC	FR
University of Southampton	UK

VortexCell2050

Fundamentals of Actively Controlled Flows with Trapped Vortices

Background

Trapping vortices is a technology used for preventing vortex shedding in flows past bluff bodies. Vortices forming near bluff bodies tend to be shed downstream. If the vortex is kept near the body at all times, it is 'trapped'. Vortices can be trapped in special cavities in the airfoil, called vortex cells but so far, trapped vortices have been stabilised only by passive means (EKIP aircraft, Russia). Active control consists of linking sensors and actuators via a control system to stabilise the flow. Active flow control has been implemented for flows past bodies of simple shape.

Project objectives

To ensure a high lift-to-drag ratio, aircraft wings are thin and streamlined. From a structural-strength viewpoint, a thick wing would be more beneficial. With an increase in aircraft size, the balance between structural-strength and aerodynamic quality shifts in favour of a thick wing. The flow past a thick airfoil, however, is likely to separate, affecting aerodynamic qualities of the wing. The present project aims to resolve this problem by combining two advanced technologies: trapped vortices and active control. The specific objectives of the project are:

- to develop a software tool for designing a flow past a thick airfoil with a trapped vortex, assuming that this flow is stable, apart from small-scale turbulence
- to develop a methodology and software tools for designing a system of stabilisation of such a flow
- to design and estimate the performance of an airfoil with a trapped vortex and a stabilisation system for the high-altitude, long endurance unmanned aircraft.

Description of Work

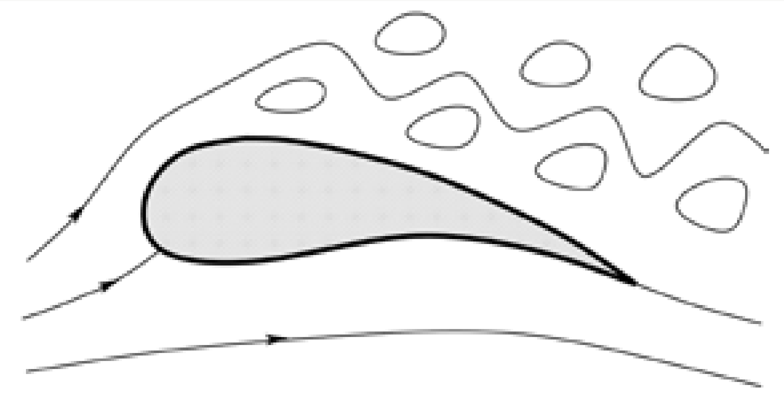
In the first of the three stages of the project, necessary numerical and experimental tools will be developed:

- a specialised experimental facility for the study of cyclic boundary layers, characteristic of flows with trapped vortices
- a wind-tunnel test-bed consisting of an airfoil with an interchangeable wall section with a vortex cell
- a discrete vortex method code as the means of testing control algorithms
- RANS code for general calculations
- LES code for studying more complicated 3D effects on simple test cases
- a vortex cell shape inverse design code incorporating a cyclic boundary layer code, and an inviscid cell design code based on various inviscid flow models.

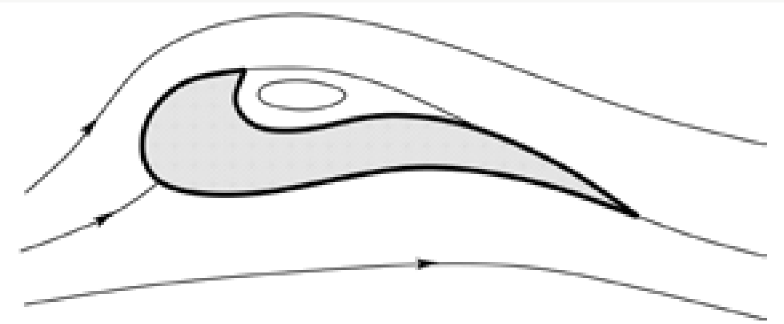
In the second stage, these tools will be used to develop and test a vortex cell for the test-bed airfoil with a system of active control. The obtained results will be used for enhancing the tools developed during the first stage of research. The differences between the intrinsic two-dimensional nature of some of the numerical tools and real three-dimensional flows will be explored, and the limitations of two-dimensional approaches will be identified. At the third stage, an attempt will be made to design a trapped-vortex airfoil for a specific practical application, namely for a high-altitude, long endurance, unmanned aircraft. Depending on the results obtained in the second stage of the research, the airfoil will be equipped with active or passive means of flow control. The wing will be manufactured and tested in a wind tunnel.

Expected results

The project will ensure a significant advance in trapped vortex technology. In the case of complete success of the VortexCell2050 project, the main outcome will be a new technological platform: an actively controlled trapped vortex technology.



Vortex shedding in separated flow on the upper surface of a thick airfoil.



Thick airfoil with a trapped vortex. VortexCell 2050 investigates this flow control concept, which may well lead to the design of thick-winged aircraft.

Acronym:	VortexCell2050
Contract no.:	AST4-CT-2005-12139
Total cost:	€2 244 413
EU Contribution:	€1 802 370
Starting date:	01/10/2005
Duration:	36 months
Website:	http://www.soton.ac.uk/~chernysh/VortexCell2050Synopsis.htm
Coordinator:	University of Southampton, Highfield, GB-SO17 1BJ Southampton
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Partners:	University of Southampton	UK
	Politecnico di Torino	IT
	Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
	Piaggio Aero Industries S.p.A.	IT
	Technische Universität München (TUM)	DE
	Battery Company RIGEL	RU
	Technische Universiteit Eindhoven	NL
	Université Bordeaux 1	FR

ADVACT

Development of Advanced Actuation Concepts to Provide a Step Change in Technology Use in Future Aero-engine Control Systems

Background

Major strides have been made in the detail of monitoring and control of gas turbine engines, though very little has changed in what is physically controlled or the actuator mechanisms themselves. This project will review the available advanced actuation technologies, identify how they can be used within a gas turbine, assess the benefits and demonstrate the technology applicability with laboratory work.

Project objectives

Recent developments in actuation mechanisms provide many opportunities for new control functions that could provide a step change in the capabilities of machines.

The prime objective of ADVACT is to enable improvements in operation, availability, costs and environmental impact of gas turbines by the provision of extended in-flight actuation and control of engine parameters. This will include localised autonomous optimisation as well as interfaces with more conventional control systems. The identified technologies will undergo extensive studies to consider the operational manufacturing, application and environmental issues.

Description of the work

The first task is a broad ranging, generic study of the benefits of extended actuation capability coupled to the development of specific technologies, which will demonstrate the capabilities for identified applications. This will provide clear quantification of the potential for these rapidly emerging technologies.

The fundamental technical work will then develop previously identified technologies towards being suitable and available for specific applications in the gas turbine environment. The technologies will be:

– Cascade airflow control – airflow through blades and vanes will be characterised, and strategies and methods for their control will be developed with the aim of providing both drag and directional control to replace mechanical Variable Guide Vanes.
– Micro Electro Mechanical Systems (MEMS) – devices suitable for use in the control of airflows will be developed to feed into other activities and to identify the way forward for commercial developments.
– Boundary layer control for intakes and diffusers will be characterised, and strategies and methods for their control developed.
– Shape Memory Alloys (SMAs) for variable nozzles and aerofoils will be improved to provide higher temperature capabilities. Manufacturing and processing methods will be developed to produce the larger forms required for gas turbine applications.
– Advanced electromagnetic actuation methods for fuel flow and tip clearance will be developed to provide direct actuation within the gas turbine environment.

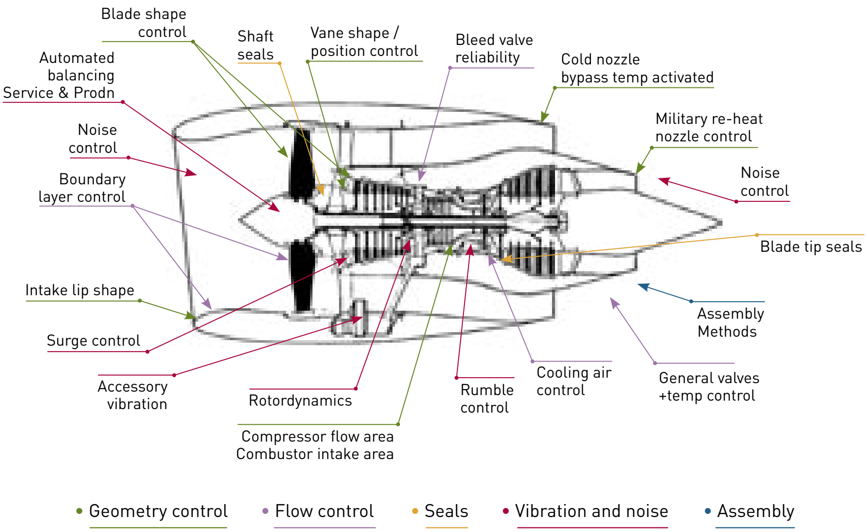
– Active vibration control strategies and equipment will be developed to provide technologies for reduced vibration transmission to the airframe.

Expected Results

The project is structured so as to provide clear visibility of the benefits to the industry and raise the credibility of advanced actuation by technology demonstrations.

These demonstrations are aimed at key requirements that are well recognised in the industry but have previously been impractical with current technologies. The benefits that have already been identified demonstrate that these technologies will be indispensable to achieving a greater market share and conforming to future legislation, particularly with respect to environmental impact.

Areas of potential application of Advanced Actuation within a gas turbine will be the focus of ADVACT



Stealth, Sensors, instrumentation and condition monitoring (not shown)

Acronym:	ADVACT
Contract No.:	AST3-CT-2004-502844
Instrument:	Specific Targeted Research Project
Total Cost:	€6 634 100
EU Contribution:	€4 394 886
Starting date:	01/07/2004
Duration:	48 months
Website:	http://www.genesys.shef.ac.uk/advact/
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Partners:	Rolls-Royce plc	UK
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	SNECMA	FR
	AVIO S.p.A.	IT
	University of Sheffield	UK
	Turbomeca S.A.	FR
	University of Birmingham	UK
	Technische Universität Dresden	DE
	Institut National des Sciences Appliquées de Toulouse	FR
	University of Cambridge	UK
	Centre National de la Recherche Scientifique (CNRS)	FR
	Industria	FR
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Politecnico di Torino	IT
	Cranfield University	UK
	Von Karman Institute for Fluid Dynamics (VKI)	BE
	DaimlerChrysler AG	DE

AROSATEC

Automated Repair and Overhaul System for Aero Turbine Engine Components

Background

The maintenance, repair and overhaul (MRO) of aero-engine components consists of a chain of different processes, for example inspection, welding, milling and polishing. Today most of these processes are carried out manually. Data acquired during one process is not available for subsequent repair operations.

Although the industry is developing improved machining equipment to automate the individual process steps, they remain separate and unconnected. This does not improve the overall process, unlike promoting data flow and factory automation throughout the entire MRO chain.

Project Objectives

One objective is to develop a data management system (DMS) that will constitute the core of automated overhaul systems for aero-engine components. As part of this innovative data management solution, the single repair process modules will be integrated to build an automated repair cell for aero-engine components.

The other objective of AROSATEC is to improve existing repair methods by employing adaptive machining technology. These technologies will make use of the information provided by the DMS and compensate for the part-to-part variation of the complex components to be overhauled.

The data flow between the adaptive repair steps will optimise the single repair technologies, as well as the efficiency and flexibility of the entire chain of repair processes for aero-engine components.

Furthermore, it will be possible to establish 'virtal' MRO workshops. The DMS will generate a data set for each individual component and handle the logistics of components and accompanying data sets. As a result, different MRO processes will be carried out at different facilities without loss of information, efficiency or quality. In addition, the efficient life cycle monitoring will be supported.

Description of work

The work of AROSATEC can be divided into two sections. One part of the development is focused on the improvement of the different process steps. The other part concentrates on the realisation of the data flow between them. In the first period of the project, the focus is on the repair of very small compressor parts, and the welding of turbine components (hot section parts) shall be investigated afterwards.

To improve inspection of parts and avoid expensive calibrated fixture elements, a laser scanning system has been developed, which is able to scan the shiny aero-engine parts without the need of spraying them. The laser is adapted to these special needs and new filter algorithms have been tested and implemented.

To examine the optimal conditions for the laser-welding process, special testing equipment was constructed. All-important laser-welding parameters are changeable to find the most suitable set-up. With these results, a near net shape welding of the aero-engine parts will be realised.

To meet the requirements of the industrial project partner concerning the accuracy of the milling process, adaptive technologies have to be implemented into the process. To compensate for the deviation of the repair parts from their nominal geometry, special adaptation algorithms are being developed and integrated.

A system for the automated tip repair for very small compressor blades has already been implemented. First tests results are promising. By integrating the adaptive technologies into the system, processes carried out manually today can be automated.

The communication between the several repair processes uses a data management system designed according to the special needs of the MRO-industry. For data transfer and data storage, the flexible XML-data format is used. With this, it is possible to connect different systems and to integrate new processes in the future without problems. Transferring the AROSATEC data to existing MRO systems is also possible. For transferring the data to and from the database, all repair technologies are equipped with suitable interfaces.

Expected results

Improving the scanning, welding and milling processes by integrating adaptive technologies should lead to better process results and should pave the way for automating repair processes, which are carried out manually today. The need for special calibrated fixtures should be minimised.

With the continuous data-flow, all data acquired in one process should be available for all the other process steps used during the MRO process chain.

Acronym:	AROSATEC
Contract No.:	AST-CT-2003-502937
Instrument:	Specific Targeted Research Project
Total Cost:	€2 297 256
EU Contribution:	€1 154 024
Starting Date:	01/11/2003
Duration:	30 months
Website:	www.arosatec.com
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Partners:	BCT Steuerungs- und DV-Systeme GmbH	DE
	Aktionsgemeinschaft luft- und raumfahrorientierter Unternehmen in Deutschland e.V. (ALROUND)	DE
	Instituto de Soldadura e Qualidade (ISQ)	PT
	Metris NV	BE
	MTU Aero Engines GmbH	DE
	SIFCO Turbine Components Ltd.	IE
	Skytek LTD.	IE

AITEB II

Aerothermal Investigations on Turbine End-walls and Blades II

Background

Today's market for civil aircraft continuously demands lighter, cheaper, more efficient, cleaner and quieter engines. For the turbine component of a competitive future aero-engine, these requirements result in higher thermal loads in the high-pressure stage due to flatter temperature traverses at the turbine inlet as a result of new combustion concepts, and hence, the need for advanced cooling concepts. Moreover, the weight and cost requirements lead to high or ultra-high lift blade concepts for the decreasing number of parts, and to unshrouded blade concepts to decrease weight while maintaining a high efficiency level. Finally, the demand for higher by-pass ratios leads to more advanced designs of interducts (so-called aggressive) in order to shorten the axial component length.

Project objectives

Consistent with the ACARE goals, the resulting impact on turbine design and aircraft systems is referenced to the baseline of proven in-flight technology for a two-stage high-pressure turbine as of 2000. The following objectives are stated for the turbine design: 20% reduction in turbine weight, 10% reduction in coolant consumption, 1.5% increase in turbine efficiency, 50% reduction in time for detailed design with state-of-the-art CFD tools and 20% decrease in uncertainty of wall temperature prediction, thereby leading to a 20% reduction in time-to-market, a 10% reduction in cost and a 1% reduction in CO_2 emissions for an entire aero-engine.

Description of the work

The project structure comprises seven Work Packages, including one devoted to project management (Work Package 7). The work in Work Package 1 focuses on aerodynamic and aerothermal investigations of high-lift technology for high and low-pressure turbines. Particular emphasis is placed on the development and testing of concepts for passive control of flow separation. Work Package 2 is targeted at the establishment of efficient cooling technologies for trailing edge cooling. Most importantly, the outcome of this work will be essential for the development of highly efficient cooling concepts for high-pressure, single stage turbines for new generation small and medium-size aero-engines. The experimental and numerical work in Work Package 3 will establish novel platform cooling approaches based on micro-hole technologies. Moreover, the aspects of passive control of secondary flows near the platform to be investigated for high-lift rotor blades will be another essential building block for the high-lift technology also investigated in Work Packages 1 and 4. The final aspects of high-lift technology to be investigated in AITEB-2 are cooling concepts for highly loaded, high-pressure turbine blades. This will be accomplished experimentally and numerically for shrouded and unshrouded blades in Work Package 4. The work in Work Package 5 is focused on aerothermal aspects of advanced ('aggressive') turbine interducts. The extensive tests planned include investigations of passive flow control aspects, and the development of breakthrough technology for unsteady heat transfer measurements will have a major impact on research methodologies in the aero-engine and gas turbine industry. The tool development resulting from the work in Work Package 6 will allow for tremendously decreased turn-around times in the detailed design phase with high-end CFD methods. Providing a highly improved CFD process, Work Package 6 can be seen as the basis for future investigations in all research areas of industrial interest.

Expected Results

The AITEB-2 project will lead to short-term benefits in terms of lighter and more efficient turbine modules, whereas the mid-term and long-term benefits of the project will be seen in combining the results of the present project with other projects running within the Sixth Framework Programme, such as AIDA and TATEF-2. By covering both aerodynamic and aerothermal aspects of ambitious future turbine designs, the development of highly efficient, low-noise and ultra-high, by-pass ratio, commercial aero engines will be possible.

Acronym:	AITEB II	
Contract No.:	AST4-CT-2005-516113	
Instrument:	Specific Targeted Research Project	
Total Cost:	€7 328 992	
EU Contribution:	€5 017 810	
Starting Date:	01/03/2005	
Duration:	48 months	
Website:	tba	
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Partners:	Rolls-Royce Deutschland Ltd. & Co. KG	DE
	ALSTOM Power (UK) Ltd.	UK
	AVIO S.p.A.	IT
	Siemens Industrial Turbomachinery Ltd. (SIT)	UK
	MTU Aero Engines GmbH	DE
	SNECMA	FR
	Turbomeca S.A.	FR
	Volvo Aero Corporation AB	SE
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Von Karman Institute for Fluid Dynamics (VKI)	BE
	Cambridge Flow Solutions Ltd.	UK
	Instytut Maszyn Przeplywowych im. Roberta Swewalskiego Polskiej Akademii Nauk	PL
	University of Cambridge	UK
	Universität Karlsruhe (Technische Hochschule)	DE
	Università degli Studi di Firenze	IT
	Chalmers Tekniska Högskola AB	SE
	Universität der Bundeswehr München	DE

TATEF 2

Turbine Aero-Thermal External Flows 2

Background

The High Pressure Turbine (HPT) is a particularly sensitive element of the engine. Nowadays, HPTs are usually heavily loaded and film-cooled, but, very often, they determine the life duration of the engine. The current trends are to continue increasing the turbine inlet temperature (and thus the efficiency of the gas turbine cycle) and the turbine stage load. This tends to reduce the engine weight but may also have a negative impact on the component's life duration.

Due to their speed and reduced costs, numerical methods are intensively used by engineers to design and analyse the different parts of the turbine stage, but gains must be made in flexibility, accuracy and fidelity of the modelling, especially in the field of heat transfer. In particular, the possibility of resolving fluctuations at frequencies related to blade passing events is becoming increasingly important.

Project objectives

Designers need to predict the heat transfer and aerodynamic losses in unsteady turbine external flows with higher accuracy. Test data acquired under representative conditions are therefore urgently needed, both at the stage scale and at the blade and coolant hole scale, and efficient and accurate prediction methods need to be developed and tested. In order to meet these needs, this project will aim to:

- enlarge the database of aerodynamic and heat transfer measurements obtained under both macroscale (turbine stage) and microscale (dedicated test rigs to investigate coolant ejection)
- validate numerical methods and assess their accuracy through comparisons with experimental data and propose new models
- gain understanding in the complex time-averaged and time-resolved behaviour of the flow field, both for aerodynamics and the heat transfer
- propose new designs that present potential reduction in weight and improvements in performances.

Description of the work

TATEF2 plans to use the critical mass in terms of test rigs, expertise, human resources and funding to go one step further and come up with breakthrough aerodynamic and aero-thermal technologies. Four main domains have been selected and will be worked on in parallel in four different technical Work Packages:

Work Package 1 is divided into three subtasks. The first assesses the MT1 turbine stage efficiency in the Isentropic Light Piston Facility (ILPF) of QinetiQ. The second subtask aims to study the temperature distortion (hot spots) at the entrance of the turbine stage. The effects of flow migration are especially studied. The third subtask investigates the swirl effects on the steady and unsteady aero-thermal performance of a cooled high-pressure turbine.

Work Package 2 is conducted in the CT3 blow down facility of VKI. It consists of four subtasks. The first aims to complete the available detailed information on the turbine stage, already investigated in two previous European projects (IACA and TATEF). Its purpose is to determine more global quantities, like mass flow, shaft power and mechanical losses. The second part is related to the knowledge of the forcing function and the unsteady heat transfer field in order to predict high cycle fatigue better, both from the mechanical and thermal point of views. The third subtask focuses on the understanding of the heat transfer process on the rotor platform. The last objective is to determine the steady and unsteady performance of an innovative low-pressure (LP) vane located downstream of the existing HP turbine stage, in which large chord structural vanes alternate with more classical short chord airfoils that have a better aerodynamic performance.

Work Package 3 is divided into three experimental subtasks. The first is related to the film cooling in transonic turbine stages. Data on investigations of shock-wave-coolant interaction is very limited in any great detail. This task addresses this lack, analysing the effects of quasi-steady and periodic unsteady shock waves on film cooling performance. The second subtask is dedicated to a detailed experimental study of the flow field inside the film cooling hole for various cross flow conditions at the hole inlet. Additionally, the flow field in the hole inlet and exit region is investigated. The first two subtasks are conducted in the University of Karlsruhe and the third takes place in EPFL. Experimental investigations are conducted to analyse film cooling effectiveness and heat transfer coefficients on a MT1 NGV profile assembled in a linear cascade. The MT1 airfoil is equipped with multi-row film cooling on pressure and suction side. Additionally, film-cooling performance on the NGV's platforms is studied.

Work Package 4 represents the CFD part among the technical work packages. It is led by the University of Florence and is composed of four subtasks. The first addresses the CFD tools for heat transfer in turbine stage components. The second subtask is related to the strategies and methods for the simulation of

MT1 turbine stage investigated in QinetiQ (WP1) unsteady stage aerodynamic and heat transfer. The third task is related to the CFD activity of the industrial partners, running simulations on selected test cases coming from the project database. This will lead to an improved validation of the CFD tools to be used for the design of the turbine components. Then the general consensus on what is relevant in the comparison, both on the research side as well as for industrial application, will be stated. The objective of the fourth task is to develop suitable post-processing methods for a critical review of the available data.

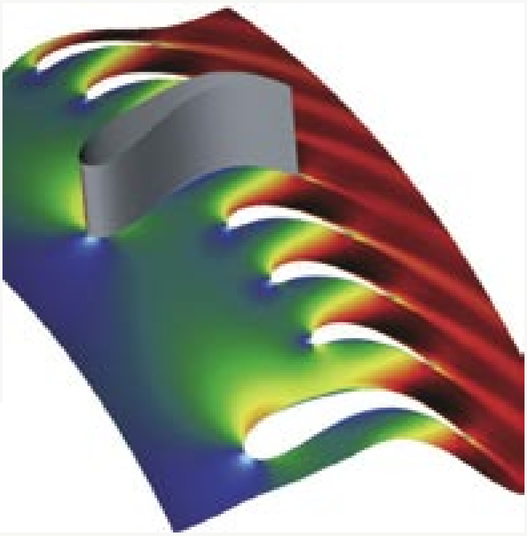
Expected results

The results of these investigations will be the following:

1. The current lack of accuracy is usually accounted for by safety margins that result in less efficient (excessive cooling) and heavier engines, and even with safety margins, the fatigue is sometimes underestimated and causes early failure. The validation and improvements of modelling in the prediction methods will yield gains in accuracy and confidence, resulting in better calculation of high-cycle fatigue and blade life cycles.

2. The understanding of the detailed physical phenomena, supported by both experiments and predictions, is a key point in improving future designs. The influence of hot spots and platform cooling on the heat load of the blades is particularly important, and microscale investigations should allow optimisation of film cooling configurations to maximise film coverage and effectiveness with smaller coolant mass flows.

3. The testing of an innovative combined aerodynamic and structural low-pressure vane, with both structural and classical airfoils, will allow assessment of the aero-thermal benefits of such configurations.



Mach number around the 2nd stator including structural struts (WP2)

Acronym:	TATEF 2
Contract No.:	AST3-CT-2004-502924
Instrument:	Specific Targeted Research Project
Total Cost:	€8 245 755
EU Contribution:	€5 232 040
Starting Date:	08/06/2004
Duration:	48 months
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Rolls-Royce Deutschland Ltd. & Co. KG	DE
QinetiQ Ltd.	UK
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Industria de Turbo Propulsores S.A.	ES
Von Karman Institute for Fluid Dynamics (VKI)	BE
Universität Karlsruhe (Technische Hochschule)	DE
Ecole Polytechnique Fédérale de Lausanne	CH
University of Oxford	UK
Università degli Studi di Firenze	IT
ACIES Europe	FR

ULTMAT

Ultra High Temperature Materials for Turbines

Background

Increasing the temperature capability of turbine blade materials has been identified as a major requirement to develop efficient and clean aircraft. For high-pressure turbine components, the development of new alloys offering increases in metal surface temperatures of as much as 150°C over the presently used Ni-base, single-crystal superalloys is of strategic importance.

Project objectives

The project aims to provide a sound technological basis for the introduction of innovative materials, namely Mo- and Nb-based Silicide multiphase alloys, which have enhanced high temperature capabilities of up to 1 300°C, compared to the presently used Ni-base single-crystal superalloys, for application in aircraft/rotorcraft engines and in aero-derivative land-based gas turbines. The objectives of the project are:

- the definition of new alloy compositions with an acceptable balance of mechanical properties and oxidation resistance
- the development of cost-effective processing technologies
- the design of coating systems to improve oxidation resistance
- the creation of a properties database, which will provide data for applications under specific turbine service conditions
- a preliminary assessment of the implementation conditions of the materials in turbines (machining, joining, etc.).

Description of the work

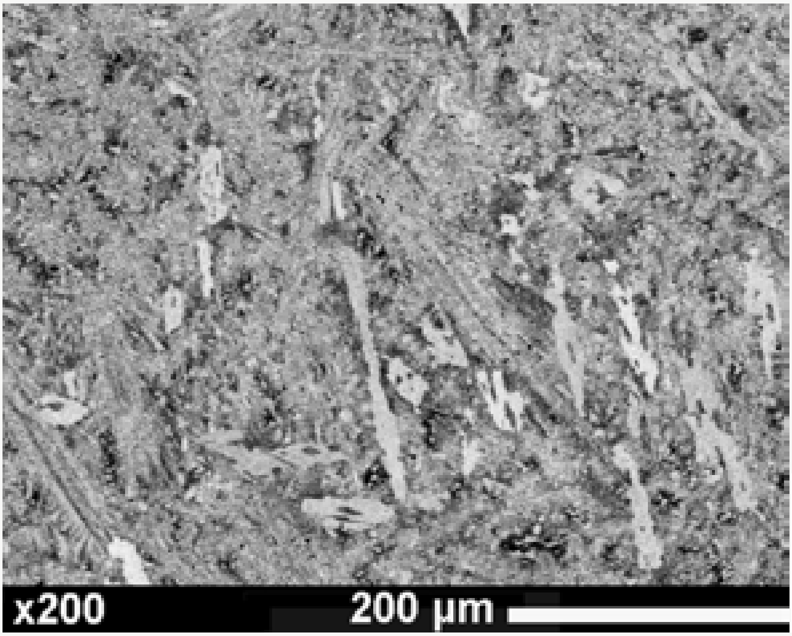
The work plan has been constructed as a fast-track programme with simultaneous efforts on all technological aspects leading to representative tests, as well as technical/economic validation:

- alloy composition development with respect to specified property requirements;
- development of cost-effective and reliable processing technologies for both Nb- and Mo-based Silicide alloys. The composition and microstructural control of the multiphase alloys is of prime importance to enhance the current state-of-the-art. Therefore, a range of processes provided by the consortium (including arc-melting, ingot casting, powder-metallurgy processing, thermo-mechanical processing, etc.) together with the expertise in intermetallic and refractory metal alloy development, will be used extensively for alloy composition screening and improvement up to the manufacturing of a prototype blade;
- development of adequate oxidation protection coatings;
- characterisation of the most relevant alloy properties (mechanical: high temperature yield strength and creep resistance, fracture toughness; physical, thermal, etc.);
- development of fabrication technologies.

Expected Results

The expected result of the project is a thorough evaluation of the capability of refractory metals, Nb- and Mo-based Silicide multiphase materials , to withstand future increased temperature turbine service conditions, relying on mechanical, microstructural and environmental investigations in close relation to industrial-scale material processing and component fabrication technologies.

Aero-engine hot section turbine blade (height: about 10 cm)



Microstructure of an arc melted Nb-silicide based alloy. Light grey: silicide dendrites

Acronym:	ULTMAT
Contract No.:	AST3-CT-2003-502977
Instrument:	Specific Targeted Research Project
Total cost:	€4 871 012
EU contribution:	€3 060 400
Starting date:	01/01/2004
Duration:	48 months
Website:	www.onera.fr/www-ultmat/
Coordinator:	Office National d'Etudes et de Recherches Aérospatiales Metallic Materials and Processing Department BP 72 FR-92322 CHÂTILLON CEDEX
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Plansee AG - High Performance Materials	AT
Rolls-Royce plc	UK
SNECMA	FR
Turbomeca S.A.	FR
Université Henri Poincaré Nancy I	FR
University of Surrey	UK
Walter a.s.	CZ

AEROMAG

Aeronautical Application of Wrought Magnesium

Background

The aluminium alloys used today for aerospace applications are already optimised as far as aeronautical requirements are concerned, such as strength, fatigue and damage tolerance properties. Magnesium, with a density of only 65% of that of aluminium, could be a breakthrough technology in the aerospace industry if used for cost-efficient, low-weight components and airframe structures. However, to use this low weight material the mechanical and technological properties have to be improved.

Project objectives

The technological objective is a weight reduction of fuselage parts, systems and interior components of up to 35%. The strategic objectives are a 10% increase in the operational capacity, a 10% reduction in direct operating cost and a 10% reduction in the fuel consumption, and therefore a reduced environmental impact with regard to emissions and noise.

Description of the work

The technical focus of the university-driven proposal, AEROMAG, which has been prepared in close collaboration with the Network of Universities 'EASN', is the development of new magnesium wrought products (sheets and extrusions), which provide significantly improved static and fatigue strength properties. The strength properties of these innovative materials are required to be as high as AA5083 for non-structural applications and as high as AA2024 for aluminium alloys for secondary structure applications.

At first new alloys will be developed and existing alloys will be tested. Appropriate manufacturing (rolling, extrusion), forming and joining technologies require development, simulation and validation for the innovative material and application. Corrosion is a problem that needs to be solved with the newly adapted and environmentally friendly surface protection systems and advanced design concepts. Flammability will be addressed with the addition of chemical elements and special surface treatments. A further essential task is the development of material models and failure criteria for the prediction of forming processes, plastic deformation and failure behaviour of components. Finally, material-adapted design and the evaluation of structural behaviour will be investigated to close the process and development chain for aeronautic components.

Expected results

Improved magnesium alloys; cost-efficient production routes for sheets and extrusions; a comprehensive material database; improved flammability behaviour; simulation tools and key parameters of forming processes; key parameters and properties of joining processes; environmentally friendly surface protection systems; definition of design rules; structural behaviour of magnesium components; weight specific cost analysis of typical components.

Acronym:	AEROMAG	
Contract No.:	AST4-CT-2005-516152	
Total Cost:	€3 834 660	
EU Contribution:	€2 492 327	
Starting Date:	01/03/2005	
Duration:	36 months	
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Partners:	EADS Deutschland GmbH	DE
	EADS CCR	FR
	All-Russia Institute of Light Alloys	RU
	Federal State Unitary Enterprise 'All-Russian Scientific Research Institute of Aviation Materials'	RU
	University of Patras	EL
	University of Thessaly	EL
	Institut National Polytechnique de Grenoble	FR
	Ecole Nationale Supérieure d'Arts et Métiers (ENSAM), Centre d'Enseignement et de Recherche d'Aix-en-Provence	FR
	Technische Universität Wien	AT
	Technion - Israel Institute of Technology	IL
	Università di Napoli 'Federico II'	IT
	Salzgitter Magnesium-Technologie GmbH	DE
	Otto Fuchs KG	DE
	ALONIM Holdings Agricultural Cooperative Ltd.	IL
	Eurocopter S.A.S.	FR
	Airbus Deutschland GmbH	DE
	Alenia Aeronautica S.p.A.	IT
	Palbam Metal Works	IL

ALCAST
Advanced Low-Cost Aircraft Structures

Background

The ALCAS project will maintain and enhance the competitive position of the European Aerospace industry, in the face of significant challenges from strong global competition. The specific aim is to contribute to reducing the operating costs of relevant European aerospace products by 15%, through the cost-effective, full application of carbon fibre composites to aircraft primary structures. The target products range from business jets to large civil airliners.

Project objectives

The objective for airliner platforms is a 20% weight saving, with a zero increase in recurring cost against metallic structures. The wing platform will build on the TANGO outer wing, from the TANGO Fifth Framework Programme (FP5) Technology Platform project, to address the most challenging parts of the inner wing structure, including engine and landing gear attachment. The fuselage platform will investigate the impact of complex fuselage design features, enhanced damage capability and system integration requirements. It is also expected to show that maintenance costs will be reduced, taking advantage of less fatigue and corrosion.

The objective for business jet platforms is a 20-30% reduction in recurring costs, with a 10% weight saving against metallic structures. The wing platform will focus on high-structural integration. Validation will be through design, manufacture and test of a full-scale wing of partial length, and a full-scale rear fuselage with sandwich construction, vertical and horizontal tailplanes and engine attachment, which will consider system installation constraints.

Description of the work

The project is organised into four technical platforms, as outlined below.

'Airliner Wing' covers the design, manufacture and testing of an inner wing and centre box of a large civil airliner, focusing on the centre box to lateral wing root joint, landing gear and pylon integration, and the highly loaded, complex curvature lower cover. The knowledge and experience gained from this platform will build on that gained from the wing platforms during the TANGO project, and will enable the full application of carbon fibre composites to primary wing structures.

'Airliner Fuselage' builds upon the knowledge gained from the TANGO Composite Fuselage platform for current fuselage areas. This platform is the next logical step towards the application of a composite fuselage to a large civil airliner. It covers component tests to address key fuselage challenges and complex design features, including large cut-outs and large damages in curved panels, keel beam and landing gear load introduction, tyre-impact damage, post-buckling and elementary crash analysis.

'Business Jet Wing' covers the application of carbon fibre composites to business jet wings, focusing on reducing costs by combining parts into an integrated wing structure, and includes architecture studies to identify the best wing joint configuration. Current technology is seen as prohibitively expensive for business jet applications, and this research is aimed at developing and validating a cost-effective solution. A business jet-sized wing structure will be designed, manufactured and tested.

The 'Business Jet Fuselage' platform covers the research required for the application of carbon fibre composites to business jet fuselages. A double curved rear fuselage with a sandwich shell, vertical/horizontal tailplanes and engine integration will be studied. It will build on the FUBACOMP FP5 project, to provide the knowledge and experience for exploitation in real products. A business jet-sized rear fuselage structure will be designed, manufactured and tested.

Expected results

Expected results include down-selection results showing which innovative technologies offer the best cost/weight benefits for structural applications. It will also provide the knowledge and experience to offer a cost- and weight-effective, full composite wing, and composite business jet fuselage. Specific understanding will be developed on high-point load inputs into composite structures, high structural integration, novel materials and joining technologies, cost effective tooling and damage analysis.

Acronym:	ALCAS	
Contract No.:	AIP4-CT-2005-516092	
Instrument:	Integrated Project	
Total Cost:	€101 277 380	
EU Contribution:	€53 460 000	
Starting Date:	01/02/2005	
Duration:	48 months	
Website:	www.alcasecproject.net	
Coordinator:	Airbus UK, Building 20A1, New Filton House, Filton GB-BS99 7AR Bristol	
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Partners:	Airbus UK Ltd.	UK
	Airbus France S.A.S.	FR
	Airbus Deutschland GmbH	DE
	Airbus España S.L.	ES
	Dassault Aviation S.A.	FR
	Advanced Composites Group Ltd.	UK
	Associación de Investigación y Cooperación Industrial de Andalucía	ES
	Alenia Aeronautica S.p.A.	IT
	ATS Kleizen	NL
	Short Brothers plc	UK
	CT Ingenieros, A.A.I, S.L	ES
	Centre d'Essais Aéronautique de Toulouse (CEAT)	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE

Technische Universiteit Delft	NL
EADS CASA	ES
EADS CCR	FR
EADS Deutschland GmbH	DE
Stork Fokker AESP B.V.	NL
Federal State Unitary Enterprise All Russian Scientific Research Institute of Aviation Materials	RU
GKN Aerospace Services Ltd.	UK
Israel Aircraft Industries Ltd. (IAI)	IL
Irish Composites (Ábhair Cumaisc Teoranta)	IE
INBIS Ltd.	UK
Instituto Nacional de Técnica Aeroespacial (INTA)	ES
Labinal	FR
Messier-Dowty Ltd.	UK
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Patria Aerostructures OY	FI
RUAG Aerospace	CH
Riga Technical University	LV
Saab AB	SE
SAMTECH S.A.	BE
SONACA S.A.	BE
Tusas Aerospace Industries Inc.	TR
Central Aerohydrodynamic Institute (TsAGI)	RU
Technische Universität Dresden	DE
TWI Ltd.	UK
University of Patras	EL
Vyzkumny a Zkusebni Letecky Ustav, A.S. (VZLU)	CZ
Helsinki University of Technology	FI
CTL Tástáil Teoranta	IE
Cranfield University	UK
University of Plymouth	UK
University of Wales, Swansea	UK
Ecole Nationale Supérieure des Arts et Industries Textiles (ENSAIT)	FR
Issoire-Aviation S.A.	FR
Military University of Technology (MUT)	PL
Università degli Studi di Pisa	IT
Kungliga Tekniska Högskolan (KTH)	SE
Seconda Universitá degli Studi di Napoli	IT
Novator AB	SE
Sigmatex (UK) Ltd.	UK
Nedtech Engineering BV	NL
Aeroforme S.A.	FR
Ecole Centrale de Nantes	FR
Composite Tooling & Structures Ltd.	UK
Ordimoule S.A.	FR
Ecole Nationale Supérieure de l'Aéronautique et de l'Espace (SUPAERO)	FR
Universidad Politécnica de Madrid	ES

COCOMAT

Improved Material Exploitation of a Safe Design of Composite Airframe Structures by Accurate Simulation of Collapse

Background

European aircraft industry demands a reduction in development and operating costs, by 20% and 50% in the short and long term respectively. COCOMAT will contribute to this aim by reducing the structural weight by expanding the limits of safe design; it will exploit considerable reserves in primary fibre composite fuselage structures by an accurate and reliable simulation of collapse. Collapse is specified by that point of the load-displacement curve where a sharp decrease occurs, thus limiting the load-carrying capacity.

Project objectives

The main objective of COCOMAT is to accomplish the large step from the current to a future design scenario of stringer-stiffened composite panels. The current industrial design scenario is illustrated in a typical load-shortening curve, which is divided into three different regions. Region I covers loads allowed under operating flight conditions and is bounded above by the limit load; region II is the safety region and extends up to the ultimate load; region III comprises the forbidden area, which reaches up to collapse. There is still a large unused structural reserve capacity between the current ultimate load and collapse. In a future design scenario like the one this project aspires to realise, the ultimate load limit is shifted as close as possible towards collapse. Another main difference to the current design scenario is that the onset of degradation is moved from the forbidden region III to the safety region II due to a reliable simulation of collapse.

Description of the work

To reach this main objective, the project will provide improved slow and fast simulation tools, experimental databases and design guidelines for stiffened panels, which take skin stringer separation and material degradation into account. The experimental database is indispensable for verification of the analytically developed degradation models, which will be implemented into the new tools, and for the validation of these tools as well. Reliable fast tools will allow for an economic design process, whereas very accurate but unavoidably slow tools are required for the final certification. The partners are co-operating in the following six technical Work Packages:

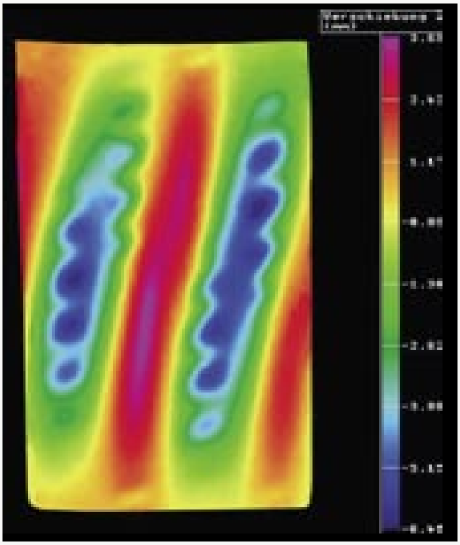
- Benchmarking on collapse analysis of undamaged and damaged panels with existing tools: knowledge of the partners is compared and the deficiencies of existing software are identified.
- Material characterisation, degradation investigation and design of panels for static and cyclic tests: material properties are characterised, degradation models are developed and test panels are designed to the requirements of the research in order to overcome deficiencies.
- Development of improved simulation procedures for collapse: slow certification and fast design tools are developed and validated by the tests.

– Manufacture, inspection and testing by static and cyclic loading of undamaged panels: the experimental database is extended by testing undamaged panels.
– Manufacture, inspection and testing by static and cyclic loading of pre-damaged panels: the experimental database is extended by testing pre-damaged panels.
– Design guidelines and industrial validation: all project results are assembled and final design guidelines derived. The tools are validated by the industry.

Industry brings experience of design and manufacture of real shells; research contributes knowledge on testing and development of simulation tools.

Expected results

The project results will comprise a substantially extended database on material properties and on the collapse of undamaged and pre-damaged statically and cyclically loaded structures, degradation models, improved slow and fast computation tools for statically loaded structures, as well as design guidelines. Although this project is orientated towards an application in fuselage structures, the results will be transferable to other airframe structures as well.



Acronym:	COCOMAT
Contract No.:	AST3-CT-2003-502723
Instrument:	Specific Targeted Research Project
Total costs:	€6 686 767
EU contribution:	€4 000 000
Starting date:	01/01/2004
Duration:	48 months
Website:	www.cocomat.de

Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Institute of Composite Structures and Adaptive Systems Lilienthalplatz 7 DE-38108 Braunschweig	
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Partners:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Agusta S.p.A.	IT
	Gamesa Desarrollos Aeronáuticos S.A.	ES
	Hellenic Aerospace Industry S.A.	EL
	Israel Aircraft Industries Ltd. (IAI)	IL
	Wytwornia Sprzetu Komunikacyjnego 'PZL-Swidnik' S.A.	PL
	SAMTECH S.A.	BE
	SMR S.A.	CH
	Cooperative Research Centre for Advanced Composite Structures Ltd.	AUS
	Swedish Defence Research Agency (FOI)	SE
	Universität Karlsruhe (Technische Hochschule)	DE
	Politecnico di Milano	IT
	Riga Technical University	LV
	Rheinisch-Westfälische Technische Hochschule Aachen	DE
	Technion - Israel Institute of Technology	IL

DATON

Innovative Fatigue and Damage Tolerance Methods for the Application of New Structural Concepts

Background

During the last few years, a set of innovative manufacturing methods have been developed, or further developed, which promise large gains in manufacturing costs in the area of aircraft manufacturing. These methods are High Speed Cutting, Laser Beam Welding and Friction Stir Welding. One of the main drawbacks of these methods is the fact that the damage tolerance of the resulting structures is not as clear as in the case of the conventional differential manufacturing method.

Project objectives

In order to allow the industry to use the newly developed manufacturing methods of (High Speed Cutting (HSC), Laser Beam Welding (LBW) and Friction Stir Welding (FSW)), which all promise high efficiency, a good damage tolerance capability under certain circumstances must be improved upon. The objective of this project to develop new methods to assess of the damage tolerance capacity of such structures. All three methods lead to a type of structure that is close to an integral structural design. This design offers benefits, such as cost savings, but there are concerns from the damage tolerance capacity point of view.

Description of work

The structure of the project follows an almost classical route to perform a project, which has the objective to develop theoretical/engineering models. It consists of an introductory task in Work Package 1. The two Work Packages (2 and 3), which are dedicated to the development of the models themselves, and the manufacturing and testing, will run in parallel, interacting from the very beginning. New theoretical ideas will be learnt from the experimental results and the work will benefit from insights discovered.

Apart from the continuous exchange between Work Packages 2 and 3, a real validation of the methods is required. This validation will take place in the latter part of the development phase. It is of special relevance that this is, to a certain extent, done by means of a 'Round Robin' procedure, i.e. different partners will use the same input data but use different models to predict theoretical results, which will also be found by one partner via an experiment.

As a consequence of the work performed in the first four Work Packages, Work Package 5 will aim to put the results of these into a common guideline and give appropriate advice on better designs of integrally stiffened structures.

Expected results

As stated above, the entire project is focused on the development of reliable tools for the assessment of the damage tolerance of integrally stiffened structures and damage tolerance characteristics.

The theoretical task, as well as the experimental task, will inevitably need to comprise of at least subtasks on crack growth and residual strength of the structures. This is reflected in all of the Work Packages.

In the theoretical area, methods of different theoretical sophistication are used by different partners. This has the big advantage that engineering tools may be checked, and that more sophisticated methods, such as finite elements or boundary elements, may be used to interpret results of the tests in a more phenomenological way.

Acronym:	DATON	
Contract No.:	AST3-CT-2005-516053	
Instrument:	Specific Targeted Research Project	
Total Cost:	€2 806 416	
EU Contribution:	€1 951 363	
Starting Date:	01/04/2004	
Duration:	36 months	
Coordinator:	Institute of Aircraft Design and Lightweight Structures TU Braunschweig Hermann-Blenk-Str. 35 DE-38108 Braunschweig	
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Partners:	Technische Universität Braunschweig	DE
	Airbus Deutschland GmbH	DE
	EADS CCR	FR
	EADS Deutschland GmbH	DE
	Israel Aircraft Industries Ltd. (IAI)	IL
	Advanced Structures and Materials Technology	NL
	Swedish Defence Research Agency (FOI)	SE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Instituto de Engenharia Mecanica e Gesto Industrial (INEGI)	PT
	Università degli Studi di Pisa	IT
	Brno University of Technology	CZ
	Sheffield Hallam University	UK
	University of Patras	EL
	Imperial College London	UK

DIALFAST

Development of Innovative and Advanced Laminates for Future Aircraft Structure

Background

New, super-efficient aircraft require new, advanced materials; therefore the development of a new generation of fibre metal laminates (FML) and metal laminates (ML) is necessary. These new laminates should provide significantly improved strength and stiffness properties for tailored fuselage applications. It is necessary to develop material models and static failure criteria for the prediction of the material behaviour of FML and ML, in both the microscopic and the macroscopic scale, for easier design with these new laminates.

Project objectives

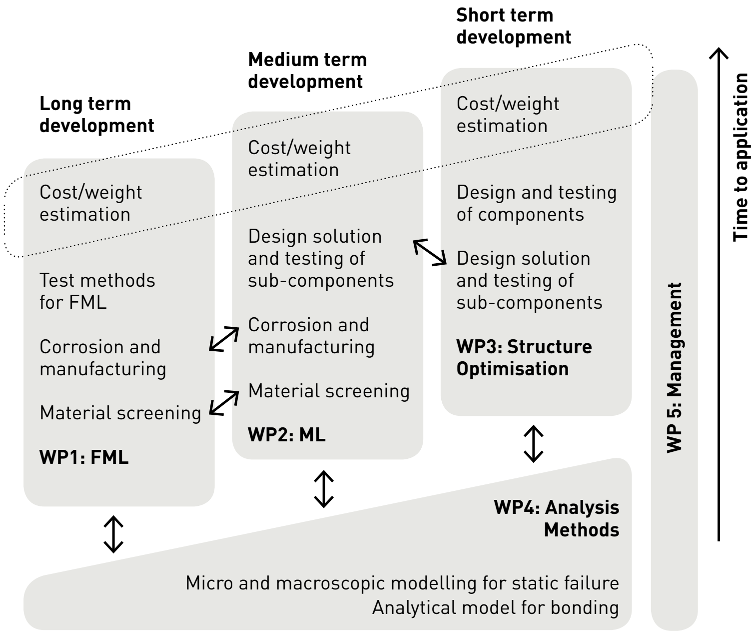
The fatigue properties of these innovative laminates, which are not yet available, are required to match those of the rather expensive GLARE® material. The objective is to attain a significantly increased static behaviour and a well-balanced combination of mechanical properties. The high manufacturing costs of FML will be reduced by using less expensive material systems, such as high performance ML. The technological objective is a fuselage skin weight reduction of up to 30% when compared to GLARE,. This is achieved by an increase in static properties. The strategic objectives are to obtain an increase in the operational capacity of 10%, a reduction in the direct operating cost of 10% and finally a reduction in the fuel consumption of 10%, thus reducing the environmental impact with regard to emissions and noise. The strategic and economic objective is a reduction in the product cost of 5% derived from a material cost reduction of 20%.

Description of the work

New fibre metal laminates and metal laminates that provide significantly improved strength and stiffness properties for tailored fuselage applications will be developed. This will be achieved by the use of alternative constituents such as new fibres, advanced metals and modified pre-preg systems. The mechanical and fatigue properties of the newly developed materials will be tested, as will the production process, which includes pre-treatment and bonding. It will be investigated if existing joining concepts are suitable for the new laminates but the manufacturing costs of FML will be reduced by using less expensive material systems such as high performance ML. Appropriate manufacturing and joining technologies require validation for the progressive laminates. Corrosion is a problem to be quantified and resolved with new sizing and treatments. Material models and static failure criteria for the prediction of the material behaviour of FML and ML in both the microscopic and the macroscopic scale will be developed and verified. Finally, optimisation criteria for the design of coupons and structural elements will be developed and experimentally verified for laminates with the aim to reduce the overall weight of the aircraft fuselage.

Expected results

The expected result is a material with significantly increased static behaviour and a well-balanced combination of mechanical properties, accompanied by a reduction of manufacturing costs of FML and a fuselage skin weight reduction. There will be an increase in operational capacity, a reduction in direct operating costs, a reduction in fuel consumption and thus a reduced environmental impact with regard to emissions and noise.



Task structure of DIALFAST, a project investigating the economical production methods and material properties of Fibre Metal Laminates and Metal Laminates.

Acronym:	DIALFAST
Contract No.:	AST3-CT-2003-502846
Instrument:	Specific Targeted Research Project
Total Cost:	€6 312 363
EU Contribution:	€3 555 357
Starting Date:	01/01/2004
Duration:	36 months
Website:	www.dialfast-project.com
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Partners:	Airbus Deutschland GmbH	DE
	Alenia Aeronautica S.p.A.	IT
	Stork Fokker AESP B.V.	NL
	EADS Deutschland GmbH	DE
	EADS CCR	FR
	Fibre Metal Laminates Centre of Competence	NL
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Institute of Structures and Advanced Materials (ISTRAM)	EL
	Technische Universiteit Delft	NL
	Università degli Studi di Pisa	IT
	Linköpings Universitet	SE

MULFUN
Multifunctional Structures

Background

The need to reduce cost is a driver for weight- and volume-constrained design on aircraft and satellites. In the last few years, lightweight composite materials have been increasingly used to reduce the structural weight of equipment components. However, concentrating solely on structural mass reduction does not lead to further reducing equipment mass, because the structure typically represents as little as 10 to 15% of the total mass. The envisaged solution is to design structural elements that can integrate multiple functions, known as multifunctional structures (MFS).

Project objectives

The project objective is the development of lightweight, fully integrated advanced equipment for aircraft and spacecraft (avionics electronic housings). Breadboards, based on the MFS technology, with a weight and volume reduction compared to their aluminium counterparts will be developed.

Description of the work

MULFUN is a specification-focused, innovation-type project, with a building block approach, according to which four breadboards will be designed and manufactured. The work plan is structured into three main phases.

The first phase begins with a general technology review of the MFS concept and the associated technology requirements (Work Package 1). After the assessment, two systems based on the two different approaches in thermal control (active and passive systems) will be designed, manufactured and tested in two technological panels (Work Packages 2 and 3).

The second phase deals with two different applications, which evaluate the technology developed in the first phase. The first design concept chosen is based on a planar array antenna for aircraft communications (Work Package 4). The second one will be a representative power electronic housing (Work Package 5), addressing the problems of assembly, EMC shielding and the integration of dummy electronics boards.

The third phase (Work Package 6) covers the exploitation aspects of the innovation produced.

Expected results

A planar array antenna and a composite-based housing that integrate thermal, electrical and structural functions will be developed. Through the proposed MFS solution, a 30% weight saving and a 50% volume reduction of the equipment is expected. The applicability of the MFS technology in the aerospace industry will also be assessed.

Acronym:	MULFUN	
Contract No.:	AST4-CT-2004-516089	
Instrument:	Specific Targeted Research Project	
Total Cost:	€2 321 000	
EU Contribution:	€1 200 000	
Starting Date:	01/01/2005	
Duration:	36 months	
Coordinator:	INASMET- Tecnalia Mikeletegi Pasealekua, 2 Teknologi Parkea ES-20009 San Sebastian	
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EC Officer:	J. Martin Hernández Tel: +32 2 295 7413 Fax: +32 2 296 6757 E-mail: Jose.Martin-Hernandez@cec.eu.int	
Partners:	Fundación INASMET	ES
	Alenia Spazio S.p.A.	IT
	Computadoras, Redes e Ingeniería, S.A. (ASTRIUM CRISA)	ES
	HTS GmbH	DE
	TTI Norte S.L.	ES
	EPSILON Ingénierie S.A.S.	FR
	RHe Microsystems GmbH	DE
	GPV PCB Division A/S	DK

NOESIS

Aerospace Nanotube Hybrid Composite Structures with Sensing and Actuating Capabilities

Background

NOESIS exploits the potential offered by Carbon Nanotube (CNT) reinforcements and focuses on developing novel nano-composite components with enhanced sensing and actuating capabilities. Small loading with conductive additives (1-5% of weight) of nanoparticles can result in (i) property enhancements comparable to those caused by conventional loadings (15-40%) of common fillers, and (ii) unique value-added properties not normally possible with common fillers. Added benefits include better processing and reduced component weight.

Project objectives

1. Formation of CNT structured assemblies embedded into resin systems for sensing/ actuating purposes and mechanical performance improvement of one order of magnitude
2. Conception and implementation of a multi-scale approach for designing nano-composites
3. Development of a coupled platform for mechanical sensing/actuating performance predictions
4. Design and fabrication of novel composite materials with increased damage tolerance, fracture toughness increased by 100%, fatigue performance improved by 30%
5. Design and fabrication of novel composite materials with tailored damping properties and a five-fold increase of damping ratio for low strain
6. Weight reduction of 10% compared to conventional equivalent CFRP components
7. Integration, modelling and validation of real-time sensing/actuating systems based on novel structural composite materials with real-time strain monitoring, scaling up of nano-actuation performance of CNTs to macro structures and life monitoring capability.

Description of the work

The project objectives will be achieved by the development of an innovative process for the design and fabrication of tailored CNT structured assemblies into a polymeric matrix, and by linking this process to a multi-scale modeling/simulation approach. It requires the implementation of innovative techniques on a manufacturing scale and an understanding of (a) the characterisation and multi-scale modeling of nano-reinforcements, (b) the fabrication, characterisation and nano-mechanics analysis of nanocomposites, and (c) the correlation of nano-structural factors with functional properties in these nano-composites.

The following activities are planned:

- Formation of CNT-structured assemblies embedded into resin systems while retaining sensing/actuating properties and providing the desired mechanical performance (an order of magnitude increase in mechanical properties compared to the state-of-the-art carbon-fibre-reinforced composites)
- Enhancement of the co-electrospinning process as a pathway to realise this potential by aligning and carrying the CNT in the form of nano-composite fibrils
- Conception and implementation of a multi-scale approach for designing nano-composites

- Development of a coupled platform for mechanical-sensing/actuating performance predictions
- Development of stimuli-response nano-composites as actuators.

The project has been organised into six technical Work Packages, a management Work Package, and a dissemination and exploitation Work Package.

Expected results

The expected results are novel composite structural components, exhibiting superior damage tolerance properties, tailored damping properties and combining sensing/actuating capabilities. CNTs in a polymer matrix form a percolated network with (i) electromechanical properties sensitive to applied stress, and (ii) an integrity that is measurable and linked to component structural integrity and its life expectancy. Roadmaps for the integration of these actuation technologies in future aerospace structural components will be provided.

Acronym:	NOESIS	
Contract No.:	AST4-CT-2005-516150	
Instrument:	Specific Targeted Research Project	
Total Cost:	€4 947 030	
EU Contribution:	€3 080 818	
Starting date:	01/04/2005	
Duration:	48 months	
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EC Officer:	José Martin-Hernandez Tel: +32 2 295 7413 Fax: +32 2 296 6757 E-mail: Jose.Martin-Hernandez@cec.eu.int	
Partners:	Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
	ATECA - Application des Technologies Avancées S.A.	FR
	Brimalm Engineering AB	SE
	Sicomp AB	SE
	Institut für Verbundwerkstoffe GmbH	DE
	Centre National de la Recherche Scientifique (CNRS)	FR
	Fundación INASMET	ES
	Centro Ricerche FIAT S.C.p.A.	IT
	Weizmann Institute of Science	IL
	Technische Universität Hamburg - Harburg (TUHH)	DE
	University of Patras	EL
	Bóreas Ingeniería y Sistemas S.A.	ES
	Israel Aircraft Industries Ltd. (IAI)	IL
	ARKEMA S.A.	FR
	Hellenic Aerospace Industry S.A.	EL

AERONET III
Aircraft Emissions and Reduction Technologies

Background

Forecasts show continuing growth of 3-4 % per year for air transport to meet the needs of a modern society. Despite very good progress and impressive reductions in aero-engine emissions, further R&D is necessary to safeguard the environmental sustainability of the future entire air transport system. ACARE set a goal to reduce, by 2020, CO2 emissions by 50% and NOx emissions by 80%. Developing the necessary technologies and making them available to the stakeholders for production and operation is essential for the future of the European aviation industry in the face of global competition.

Project objectives

The AERONET III Coordination Action is a platform where all the stakeholders in the air transport system can meet, exchange information, views and experiences gathered in different EC projects and national programmes with regard to aircraft emissions and reduction technologies. In this context, and to support the general goal of reducing aviation emissions, AERONET III provides the tools to:

- exchange information gathered in the different aviation emissions-related projects of the Sixth Framework Programme in Aeronautics, related projects in the Atmospheric Research Programme, and in other areas such as transport or energy;
- raise the level of personal and corporate knowledge and confidence within the community;
- identify gaps in knowledge and needs for further research and development, and facilitate the development of the appropriate research proposals;
- support interdisciplinary relationships and increase knowledge through joint actions such as workshops, meetings, studies and reports;
- support the policy and regulatory process by utilising the potential of the AERONET III forum to generate policy-relevant material.

Description of the work

AERONET III is a platform where stakeholders can exchange information, views and experiences. It consists of 11 thematic areas supported by a Coordination and Management Team, a Steering Group and a Policy Liaison Group. The areas are: Aircraft Technology, Engine Technologies, Fuels, Emissions Indices, Measurement Technology, Aircraft Plumes, Emissions-Noise, Air Traffic Management, Air Transport Development, Emissions Inventories, and Air Transport Systems Interaction Models. They are clustered within three Work Packages:

1. Aircraft and engine technology aspects of emissions reduction;
2. Airport air quality;
3. Air Transportation Environmental System.

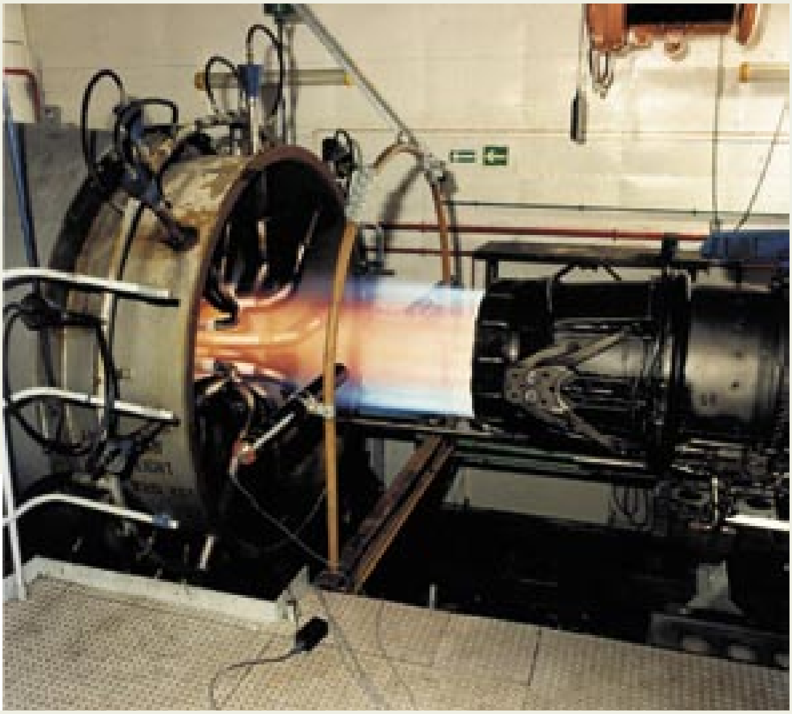
Through these Work Packages and Thematic Areas the stakeholders exchange knowledge and information in order to support the overall European aeronautical strategic context and development with respect to aviation emissions and reduction technologies. The mechanisms used for dissemination are:

- Workshops: These are planned on an annual basis and according to the needs of the community. The workshop proceedings are confidential and restricted to the partnership and the participants. A summary is accessible to the public through the AERONET website. Important workshop topics are, for example, the 'airport air quality' issue with an objective to contribute to a reliable assessment of air traffic's contribution to airport air pollution, the 'fuel thermal stability' issue in advanced combustors, and the 'hydrogen as a potential aviation fuel' issue plus the associated problems of storage and handling.

– Studies: According to the needs of the community, the Co-ordination and Management Team (CMT) identifies particular topics that are not necessarily appropriate to a dedicated workshop but that form a vital input to another workshop. Examples for studies are 'potential for reducing the NOx emissions for hydrogen and kerosene-fuelled aero gas turbines' or 'review of hydrocarbon (HC) speciation at airports and potential for local air pollution'.
– Website: The AERONET website contains information on AERONET activities, links to related projects and networks, a library section with publishable reports and documents and a partner section containing documents (e.g. workshop reports, studies) restricted to the partners.

Expected achievements

AERONET will continue through its networking activities to support the overall aeronautical environmental goal of substantial aviation emissions reduction by providing the stakeholders with a platform that can be used to exchange technical information and identify knowledge gaps, but also to support the policy and regulatory process.



Optical measurement of exhaust: the dissemination of the results of research of this kind, i.e. on aero engine noise and emissions, is the main objective of AERONET III.

Acronym:	AERONET III	
Contract No.:	ACA3-CT-2003-502882	
Instrument:	Coordination Action	
Total Cost:	€1 799 400	
EU Contribution:	€1 799 400	
Starting Date:	01/04/2004	
Duration:	48 months	
Website:	www.aero-net.org	
Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Linderhöhe DE-51147 Köln	
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Partners:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Swedish Defence Research Agency (FOI)	SE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Manchester Metropolitan University	UK
	University of Sheffield	UK
	Air BP Ltd.	UK
	Airbus UK Ltd.	UK
	Auxitrol S.A.	FR
	Bergische Universität Gesamthochschule Wuppertal	DE
	Deutsche Lufthansa A.G.	DE
	EUROCONTROL - European Organisation for the Safety of Air Navigation	INT
	Forschungszentrum Karlsruhe GmbH	DE
	Gromov Flight Research Institute	RU
	Instytut Lotnictwa	PL
	QinetiQ Ltd.	UK
	Rolls-Royce plc	UK
	Rolls-Royce Deutschland Ltd. & Co. KG	DE
	Shell Aviation Ltd.	UK
	SAFRAN S.A.	FR
	Universität Karlsruhe (Technische Hochschule)	DE
	Flughafen Zürich A.G. - Unique	CH
	MTU Aero Engines GmbH	DE
	National Technical University of Athens (NTUA)	EL
	Federal Office for Civil Aviation (FOCA)	CH

AEROTEST

Remote Sensing Technique for Aero-engine Emission Certification and Monitoring

Background

It has been demonstrated in the last five years, via AEROJET and AEROJET II, that non-intrusive techniques like Fourier Transform Infrared spectroscopy (FTIR) and Laser Induced Incandescence (LII) are relevant to the measurement of aero-engine exhaust gases. These methods have been compared with intrusive methods within AEROJET II.

This success has opened the path for their standardisation. Simultaneously, the aircraft engine industry stresses the need for a measurement method compatible with cost effectiveness, short-term implementation, fast availability of results and accuracy, meeting ICAO emission certification needs.

Project objectives

The aim of AEROTEST is to achieve a high level of confidence in aircraft engine emission measurements with a view to using the remote optical technique for engine emissions certification. Two major objectives will allow meeting the engine manufacturers' needs:

- the first and major objective is to address the standardisation issues, the ultimate aim being to promote non-intrusive techniques to ICAO for engine emission certification, following a complete quality assurance (QA) and quality control (QC) approach, and developing procedures for calibration, set up and operation.
- the second objective is to develop validated techniques for gas turbine monitoring, using emissions data, which is to be used routinely by engine manufacturers, both in development test programmes and for engine health monitoring (EHM).

Description of the work

Six Work Packages have been defined to reach the AEROTEST objectives:

- Work Package 1 addresses all the quality aspects to be taken into account and defines the QA/QC approach to be followed to achieve the level of confidence and reliability needed for certification. It also addresses standards matters and correlation with previous intrusive data. This Work Package is essential in the sense that it defines the parameters that will insure the quality of the data, both from instrumentation and operation viewpoints.
- Work Package 2 is dedicated to the measurement methods calibration, namely the LII and the FTIR techniques. The calibration and measurement validation tests will be done both in laboratory and test bed environments.
- Work Package 3 is about the integration of the LII and the FTIR components into a unified system controlling both the LII and FTIR, and acquisition and processing. Input or control parameters will be minimised and the data processing will be automated. Non-expert operators will also be able to obtain measurements with this system.
- Work Package 4 is focused on emerging technologies. The consortium needs to be aware of such technologies that could bring simplification to the system. It is organised in thematic areas and will insure that the knowledge is distributed across the consortium. Despite its small size, Work Package 4

was felt to be important enough to be independent.

- Work Package 5 highlights the fact that the technique can serve not only as a certification tool but also for other purposes, such as the application to gas turbine health monitoring. A model of engine emissions affected by component failure will be developed and correlated to engine emissions measurements.
- Work Package 6 is focused on the dissemination of the results and the outcome of the project. Awareness feedback from standards and regulation authorities is very important to the project, and will be achieved in this Work Package.

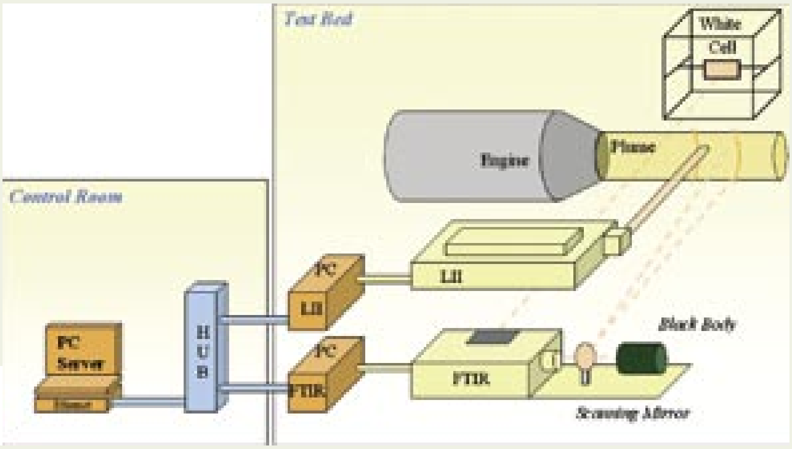
Expected Results

The expected achievement is the acceptance of non-intrusive methods for gas turbine monitoring. A proposition of recommended practices to ICAO will be established at the end of the project, taking into account feedback from certification authorities acquired during discussions and presentations.

Although AEROTEST is limited to gas turbines, the same techniques can be applied to other types of exhausts, leading to a wide range of possibilities in health and continuous emissions monitoring.

Non-intrusive equipment in a test rig

Acronym:	AEROTEST
Contract No.:	AST3-CT-2004-502856
Instrument:	Specific Targeted Research Project
Total Cost:	€3 691 900
EU Contribution:	€2 498 900
Starting Date:	01/03/2004
Duration:	36 months



AEROTEST equipment implementation

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Partners :

Auxitrol S.A.	FR
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KEMA Nederland B.V.	NL
SC OPTOELECTRONICA 2001 S.A.	RO
Forschungszentrum Karlsruhe GmbH	DE
Bergische Universität Gesamthochschule Wuppertal	DE
Rheinisch-Westfälische Technische Hochschule Aachen	DE
Lunds Universitet	SE
Centre National de la Recherche Scientifique (CNRS)	FR
University of Reading	UK
National Technical University of Athens (NTUA)	EL

AIDA

Aggressive Intermediate Duct Aerodynamics for Competitive and Environmentally Friendly Jet Engines

Background

In multi-spool jet engines, the low-pressure (LP) system has a much lower rotational speed and larger radius than the high-pressure (HP) core system. Hence, intermediate S-shaped transition ducts are needed to connect the high-radius LP system with the low-radius HP system. These annular ducts often carry loads, support bearings and have thick structural struts passing through them, making them large, heavy and expensive structures of considerable complexity. In modern aircraft engine design, there is a constant pressure to decrease weight and noise, and increase both performance and time-to-market. Transition-ducts that are more aggressive have become a key to meet these demands on future engines.

Project Objectives

The AIDA project will strengthen the competitiveness of the European aero-engine manufacturers and decrease environmental impact through the achievement of the technical objectives, which are given below:

- improved understanding of the flow physics in aggressive intermediate ducts
- system integration – knowledge of how aggressive ducts interact with neighbouring components
- development and tests of a new class of very aggressive intermediate ducts
- assessment of new advanced vane-duct integration concepts
- establishment of validated analysis methods and 'CFD Best Practice Guidelines' for duct flows
- tests and modelling of novel passive separation control devices for super-aggressive ducts
- development of new numerical optimisation techniques for intermediate ducts
- establishment of design rules and a validation database for aggressive intermediate ducts.

The quantitative project targets are 20% shorter ducts, or 20% increase in duct radial offset or 20% increase in duct diffusion rate. Duct design lead-time and risk for late and serious duct-related component integration problems will also be reduced by 50%.

Description of the work

All the European aero-engine manufacturers, three leading research institutes and five highly reputed universities have concerted their efforts to reach beyond the state-of-the-art in intermediate duct design. The project's team of 18 experts are dedicating their time to achieving these objectives over four years.

The project is structured into one managerial and six technical Work Packages:

- Fundamental Investigation of Aggressive Compressor Ducts
- Fundamental Investigation of Transition Ducts for Turbines
- New Concepts and Integrated Compressor Duct Design
- Passive Flow Control and Shape Optimisation
- CFD Analysis of Aggressive Transition Ducts
- Data Integration and New Design Rules.

The test facilities that will be mobilised by the AIDA project include some of the best experimental centres of excellence of Europe. One single-spool and one two-spool low-speed compressor facility will be supported by one high-speed compressor rig to carry out eight different measurement campaigns to push the design limits for ducts, with or without struts or swirl. The interturbine duct design space will be improved by resorting to five experiments in one low-speed and one high-speed turbine facility. The design space will be further improved by making use of two complementing measurement campaigns to assess the optimal passive control devices for intermediate ducts. Duct shape optimisation and computational predictions will be used to support experiments by providing pre- and post-test flow predictions, for instance, or by optimising the duct geometries even further.

Expected Results

The exploitation of the project's technical achievements will strengthen competitiveness and decrease environmental risk due to the impact on overall engine characteristics, enabling a 1-2% reduction in engine weight and length, 0.5% and 1.5 % increase in compressor and turbine efficiency respectively, 5% reduction in engine development costs and 10% reduction of engine time-to-market. These improvements will also have an impact on aircraft systems, leading to a 2% reduction in fuel burn and CO2 emissions, 2.5% better operating margin for long-haul aircraft, and will act as an enabler for new classes of low-noise engines.

Acronym:	AIDA	
Contract No.:	AST3-CT-2003-502836	
Instrument:	Specific Targeted Research Project	
Total Cost:	€8 221 717	
EU Contribution:	€5 607 325	
Starting Date:	01/02/2004	
Duration:	48 months	
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Partners:	Volvo Aero Corporation AB	SE
	Rolls-Royce plc	UK
	MTU Aero Engines GmbH	DE
	SAFRAN S.A.	FR
	Turbomeca S.A.	FR
	Rolls-Royce Deutschland Ltd. & Co. KG	DE
	AVIO S.p.A.	IT
	Industria de Turbo Propulsores S.A.	ES

Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Swedish Defence Research Agency(FOI)	SE
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
University of Cambridge	UK
Loughborough University	UK
Chalmers Tekniska Högskola AB	SE
Technische Universität Graz	AT
Università degli Studi di Genova	IT

CELINA

Fuel Cell Application in a New Configured Aircraft

Background

The CELINA project meets the goals of Vision 2020 in respect of:

- more efficient aircraft
- improving passenger comfort
- less negative environmental impact.

The application of fuel cell systems is a step towards more electric aircraft configuration. The expected improvements for fuel cells applied in power supply are a reduction of fuel consumption, noise and gas emissions and significantly higher aircraft efficiency. This efficiency improvement is due to a more efficient fuel conversion in comparison to the current APU .

Project objectives

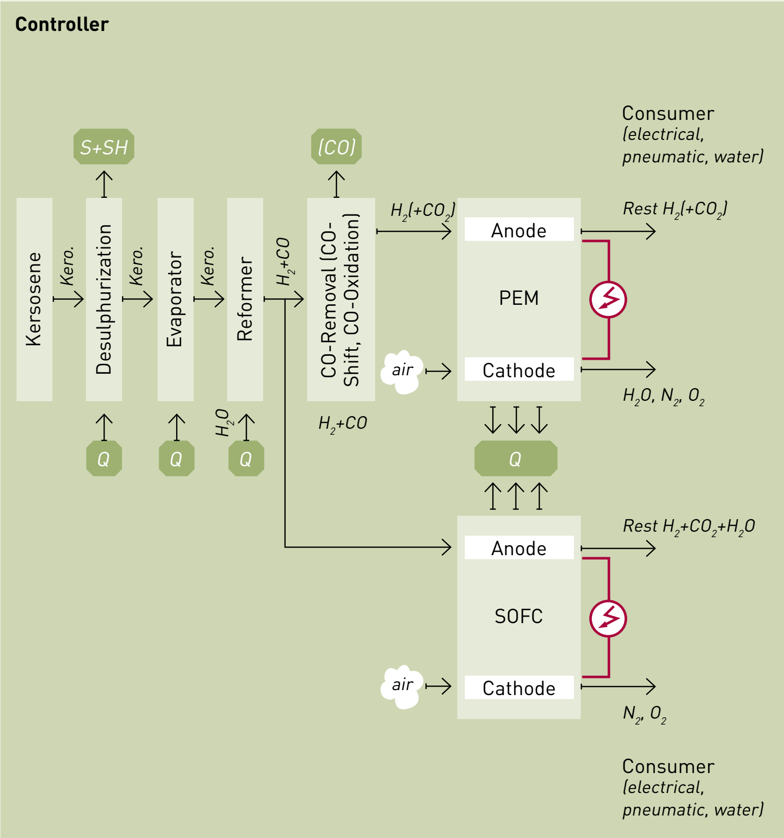
- Generation of basic aircraft requirements for a fuel cell power system regarding safety and certification, including safety assessment.
- Generation of emergency power supply network requirements, including power conversion.
- Investigation of the technical capabilities of an existing fuel cell system under aircraft operating conditions and identification of the needs for aircraft design.
- Investigation of the behaviour and limiting conditions of the fuel cell system in terms of different system parameters, such as performance output, electrical, thermal and mass flow management, and air supply.
- Definition of a controller and fuel cell control laws based on airworthiness requirements.
- Generation of aircraft integration strategies and simulation within the aircraft environment.

Description of work

In next-generation aircraft, pneumatic and hydraulic systems will be gradually replaced by electrical systems. The goal for the future is to find a highly efficient primary electric power source. Fuel cell systems have the potential to become this primary power source. As a nearer-term application with higher adoption probability, the project will investigate using a fuel cell-based system as an emergency power supply. A feasibility study will be carried out to clarify in which operational scenarios (for example stand-by, continuous running or power storage) the fuel cell system is able to work. The technical focus of the project is therefore the investigation of the technical capabilities of an existing fuel cell system under aircraft operating conditions and the identification of the needs for an airworthy design. Investigations of the behaviour and limiting conditions of the fuel cell system in terms of different system parameters, such as performance output, thermal management, mass flow, cooling and air supply, will be carried out. For these investigations, dynamic simulation models of a fuel cell stack and a kerosene reformer will be used and validated as far as possible by tests. The operational behaviour of the complete fuel cell system, including the kerosene reformer, fuel cell stack, air supply and all subsystems, will be investigated in terms of aircraft environment operational conditions, load conditions, thermal management, mass flow, performance, air supply and cooling, based on simulation models. The differences between the current fuel cell systems and an airworthy design will be worked out and the technical steps that have to be taken to develop such a system will be deduced. Another focus of the project is the definition of all relevant safety and certification requirements for the fuel cell system; a preliminary safety assessment for a fuel cell system aboard an aircraft will be carried out. A further es-sential task is the integration trade-off study of the fuel cell system into the aircraft environment, including the inves-tigation of integration strategies and con-cepts.

Expected Results

– Definition of certification and safety requirements including safety assess-ment confirmed by EASA.
– Definition of aircraft electrical network and advanced air-conditioning system requirements.
– Identification of the differences between the current fuel cell systems and an aircraft-applicable design.
– Identification of the technical steps, which have to be taken to develop an airworthy fuel cell power system.
– Development of aircraft integration concepts and strategies.
– Determination of fuel cell system behaviour under aircraft operating conditions.
– Accurate operational scenarios for fuel cell systems aboard an aircraft.



Acronym:	CELINA
Contract No.:	AST4-CT-2005-516126
Instrument:	Specific Targeted Research Project
Total Cost:	€8 141 350
EU Contribution:	€4 499 900
Starting Date:	01/01/2005
Duration:	36 months
Website:	www.airbus.com
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Partners:	Airbus Deutschland GmbH	DE
	Airbus France S.A.S.	FR
	Air Liquide	FR
	Inéva – CNRT L2ES	FR
	Dassault Aviation S.A.	FR
	Diehl Avionik Systeme GmbH	DE
	EADS Deutschland GmbH	DE
	Energy Research Centre of the Netherlands (ECN)	NL
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Germanischer Lloyd AG	DE
	IRD Fuel Cell A/S	DK
	Joint Research Centre - Institute for Energy (JRC - IE)	INT
	Institut Jozef Stefan (IJS)	SL
	Institut National Polytechnique de Toulouse - Laboratoire d'Electrotechnique et d'Electronique Industrielle (INPT - LEEI)	FR
	THALES Avionics Electrical Systems S.A.	FR
	Technische Universität Hamburg - Harburg (TUHH)	DE
	Universität Hannover	DE
	University of Patras	EL

ECATS
Environmental Compatible Air Transport System

Background

The January 2001 report 'European Aeronautics: A Vision for 2020', set the goal for Europe to become the uncontested world leader in the field of aeronautics by 2020. Reducing the environmental impact of air transport, with regard to emissions and noise, is a key element in achieving this goal. To facilitate the timely achievement of this goal a common framework for research and technological development, based upon a coordinated collaborative effort, is a pre-requisite. ECATS will develop a robust research framework and deliver outputs that focus on the environmental competitiveness and sustainability of the air transportation system concerning emissions.

Project objectives

The ECATS Network of Excellence (NoE) comprises a number of leading research establishments and universities and will provide the basis for a durable and long lasting means of co-operation in the field of aeronautics and the environment. The overall goals of ECATS are to create a European Virtual Institute for research on environmentally compatible air transport; to develop and maintain durable means for co-operation and communication within Europe and to strengthen Europe's excellence and its influential role in the international community.

The Joint Research Programme will address engine technology, alternative fuels, the impact of aviation on air quality, operational aspects of aviation and the development of alternative scenarios. Lasting integration will be achieved by joint decision-making processes and joint management and working structures, and will be supported through specific integration activities including a common web-based information and communication system, common education, training and exchange programmes, coordinated use of facilities and equipment, dissemination and joint management of innovation.

Description of the work

In the integrating activities, the ECATS Network will create a common level of knowledge on expertise and resources within the partnership by gathering and assessing information on existing research programmes, knowledge, equipment, facilities and infrastructure within the ECATS consortium. A Network Office will play a central role in the structure of the Network and serve as point of contact for communication. Within the NoE, efficient use of existing infrastructure will be managed, any lack of facilities will be identified, and duplication of resources and facilities will be minimised. A critical function of ECATS will be to identify the research landscape required to address the impact of aviation emissions on the environment. It will also assess its collective strengths and weaknesses, and its ability to meet the research objectives. This assessment, or gap analysis, will identify where work is required and will be used to identify the needs of the virtual centre. Needs may be identified in a number of areas and may be of various types, for example tool requirements, infrastructure requirements, skill deficiencies, etc. Mobility of researchers and the exchange of knowledge and experience between partners will be fostered and facilitated.

Joint research will be carried out in the capability enhancement and research initiatives activities. Three key thematic areas are (1) initial pollutant formation in engines and the subsequent chemical and physical transformation of constituents through the engine in the engine plume, (2) local and regional air quality, and (3) environmentally sustainable air traffic management and air traffic scenarios.

For spreading of excellence, the ECATS Network will utilise information and share it with external communities of aviation, atmospheric science and industry. Education and training of research staff will be a critical function of ECATS and this will be addressed through the development of common PhD programmes, summer schools and in the longer-term MSc programmes. The education and training of ECATS partners will also be supported through workshops and seminar activities. Linkages to other projects within national and EU programmes and organisations, which have interests that are aviation-environment related, will be established and managed through interface management. ECATS will disseminate research and scientific deliverables to both the scientific community and the general public.

Expected results

ECATS will integrate competences across three thematic areas: emissions and fuel, airport air quality, and green flight scenarios. There are two fundamental deliverables of ECATS:

1) the development of a durable Network of Excellence which has a common vision and understanding of the needs of the aviation industry
2) the development of an integrated and efficient skills and resource base to support Vision 2020.

These high-level deliverables are underpinned by a raft of others including common training and education programmes.

Acronym:	ECATS
Contract No.:	ANE4-CT-2004-12284
Instrument:	Network of Excellence
Total Cost:	€7 293 700
EU Contribution:	€6 922 000
Starting Date:	15/01/2005
Duration:	60 months
Website:	www.pa.op.dlr.de/ecats
Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR) Institute of Atmospheric Physics Oberpfaffenhofen DE-82234 Wessling
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Partners:		
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Swedish Defence Research Agency (FOI)	SE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Forschungszentrum Karlsruhe GmbH	DE
	Bergische Universität Gesamthochschule Wuppertal	DE
	Manchester Metropolitan University	UK
	University of Sheffield	UK
	Universitetet i Oslo	NO
	Universität Karlsruhe (Technische Hochschule)	DE
	National Technical University of Athens (NTUA)	EL
	University of Patras	EL
	National Kapodistrian University of Athens	EL

ECARE+

European Communities Aeronautics Research +

Background

The participation of research-intensive SMEs in EC-funded research has always been a challenge in the area of aeronautics, considering the high level of structuring achieved by the supply chain in this particular field. However, the new instruments implemented by the Sixth Framework Programme (FP6) with the objective of structuring the European Research Area, have been considered by many SMEs as a major hindrance on the road to participation, making it an even greater challenge than during the Fifth Framework Programme (FP5).

ECARE+, following the ECARE project, aims at fostering partnerships between large companies and SMEs, as well as between SMEs from different aeronautics regions of Europe.

Project objectives

ECARE+ follows up on the ECARE project (2003-2005), funded under FP5. It is planned to enlarge upon the tasks and the results of the first project. The final objective is to imrove the involvement of research-intensive aeronautical SMEs into EC funded research (Integrated Projects and STREPs), following a method adapted from the ECARE project, its identified best practices and its lessons learned:

- A core group of eight partners (including six aeronautical regional clusters and benefiting from the support of an already established group of 11 other clusters) will further expand in order to involve up to 30 regions.
- Information seminars on FP6 and FP7 (Seventh Framework Programme) opportunities will be organised, and SME capabilities will be assessed in order to expand the already existing database of companies to 300 entries. Partner search functionalities will be installed on the project's website.
- SME capabilities will be relayed to the IP coordinators after fine-tuning by ECARE+.

Ongoing collaboration with AeroSME and SCRATCH will be maintained and increased. Dialogue will be established with the regional governments or programmes as well as with the large companies in charge of coordination or aeronautical IPs.

The project duration will be 30 months, in order to cover the end of FP6 and the launch of FP7.

Description of the work

In the first phase, ECARE+ will expand its core group from what it was at the end of the ECARE project (17 clusters in the network) to 30 clusters. Common tools and methods will be discussed and implemented. Regional points and contacts will be trained for the subsequent project activities. The training will allow the ECARE Group partners to become fully operational for the project activities, and to become effective relays to SMEs in their region.

In the second phase, regional sessions will be organised in the 30 ECARE+ regions, with the aim of preparing SMEs to the first Call for Proposal of FP7 in the field of aeronautics. The ECARE+ sessions will present the opportunities of the first FP7 calls and the ECARE method to support participation of SMEs in IPs.

Once this information is disseminated during the regional sessions, the ECARE+ contact points will assess the technological capacities of SMEs and their willingness to bring a value-added participation to an IP. The ECARE+ database will expand from 200 to 300 entries and will be updated for each call during the life of the project. Small groups of SMEs will be identified and transmitted to each IP coordinator.

During this process, a strong focus of ECARE+ will be fostering partnerships between SMEs from different regions, with the aim of establishing trans-regional clusters for research or business.

ECARE+ will work in close collaboration with the other EC-funded support measures in the field of aeronautics, AeroSME and SCRATCH.

Expected results

ECARE+ will foster partnerships

- between European aeronautics clusters
- between SMEs from different clusters
- between SMEs and large companies in the frame of FP7 Integrated Projects.

ECARE+ will organise 20 information seminars called "Regional Sessions" and will expand its SME databases to include up to 300 SMEs.

ECARE+ will establish common tools and methods between 30 European aeronautic clusters, and will take an active part in the dialogue between the various aeronautic regions of Europe.

Acronym:	ECARE+	
Contract No.:	ASA4-CT-2005-016087	
Instrument:	Specific Support Action	
Total Cost:	€535 000	
EU Contribution:	€535 000	
Starting Date:	not yet defined	
Duration:	30 months	
Website:	www.ecare-sme.org	
Coordinator:	European Federation of high tech SMES Washingtonstraat, 40 BE-1050 Brussels	
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EC Officer:	Jean-Pierre Lentz Tel: + 32 2 296 6592 Fax: + 32 2 296 3307 E-mail: jean-pierre.lentz@cec.eu.int	
Partners:	European Federation of high tech SMEs	BE
	Association Nationale de la Recherche Technique (ANRT)	FR
	Wales Aerospace	UK
	Comité Richelieu	FR
	Cluster de Aeronautica y Espacio del Pais Vasco (HEGAN)	ES
	East Sweden Development Agency (ESDA)	SE
	Technapoli	IT
	Centre for Technology and Innovation Management (CeTIM)	DE

ELECT-AE

European Low Emission Combustion Technology in Aero Engines

Background

European companies are joining their research capabilities to promote the develop-ment of viable low emission combustion systems on a pre-competitive level.

Project objectives

The timescale for the development of aero-engine combustors is long but there is a clear vision and forecast of environmental needs. The ambitious ACARE targets, especially the demand for 80% reduction of NOx emissions from aviation, require very well focused and balanced RTD initiatives for the near future, to prepare the technology for a successful implementation of a new generation of aero-engine combustors and, therefore, a highly integrated research strategy platform. ELECT-AE will provide the impetus to bring together the key engine manufacturers and research establishments to enable this. The development of a concerted research strategy involves many complex interactions, and the continuous improvement of the corresponding processes and perspectives will ultimately provide good coordination.

Description of the work

The CA 'European Low Emission Combustion Technology in Aero-Engines' is dedicated to the support of the implementation of the goals of Vision 2020, i.e. strengthening the competitiveness of the European jet engine manufacturers and minimising the environmental impact of civil aviation with regard to emissions, thus generating economical and ecological benefits for European society.

Actions designed to support the establishment of a pre-competitive research strategy in respect to actual measures and actions in the context of combustion technology for low emission of pollutants will be taken:

- Strategy on How-To-Do technology development
- Integration and strengthening of the European Research Area
- Enhancement of technology exploitation in Europe
- Dissemination of European research results and exchange of information
- Search and identification of appropriate SMEs and capable research partners in the EU and from new Member States.

Expected results

The global result will be an improvement of the efficiency of research and further increase in the rate of progress and innovation in the field of low NOx aero-combustion in Europe.

Acronym:	ELECT - AE
Contract No.:	ACA4 - CT - 2005 – 012236
Instrument:	Coordination Action
Total Budget:	€1 492 003
EC Contribution:	€1 492 003
Starting Date:	01/01/2005
Duration:	48 months
Website:	www.elect-ae.org
Coordinator:	Rolls-Royce Deutschland Ltd. & Co KG Combustor Aerothermal & Fuel Preparation Eschenweg 11 DE-15827 Blankenfelde - Dahlewitz / Berlin
Contact:	Ralf von der Bank Tel: +49 33708 61373 Fax: +49 33708 6511373 E-mail: Ralf.von_der_Bank@rolls-royce.com
EC Project Officer:	Daniel Chiron Tel: +32 2 295 2503 Fax: +32 2 296 6757 E-mail: Daniel.Chiron@cec.eu.int

Partners:	Alstom Power (UK) Ltd.	UK
	AVIO S.p.A.	IT
	MTU Aero Engines GmbH	DE
	Rolls-Royce plc	UK
	Rolls-Royce Deutschland Ltd. & Co. KG	DE
	SNECMA	FR
	Turbomeca S.A.	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR

INTELLECT D.M.

Integrated Lean Low-Emission Combustor Design Methodology

Background

The objective of this project is to develop a design methodology for lean burn, low-emission combustors to achieve a sufficient operability over the entire range of operating conditions whilst maintaining a low NOx emission capability. A knowledge-based design system will form the framework to capture existing combustor design knowledge and knowledge generated in this project.

Project objectives

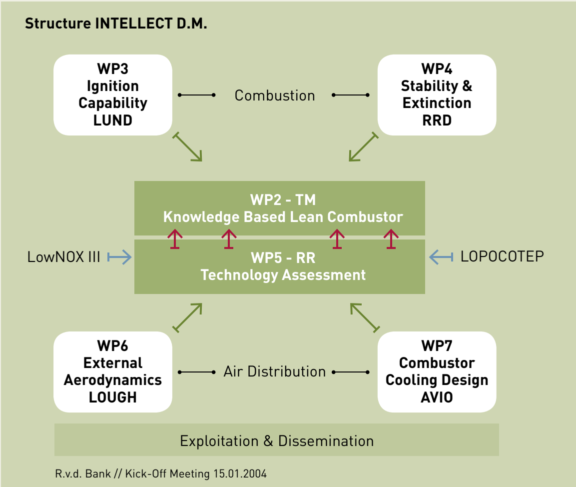
Through a pressing demand for emissions reduction, very ambitious future NOx reduction targets of 80% by 2020 have been set. Existing design rules, for conventional combustion systems, cannot be applied for lean low-emission combustors. It is therefore important to define new design rules quickly, so that the new technology can be incorporated faster into future products.

The aim is to create the first building blocks of such an integrated combustor design system. The system will incorporate preliminary design tools to make first estimates of the arrangement for lean burn combustion, which meets operability, external aero-dynamics, cooling and emissions needs.

Description of the work

Guidelines for the design of lean low NOx combustors for reliable and safe operation will be derived. These guidelines will be incorporated in the knowledge-based combustor-engineering tool in order to strengthen European competitiveness by reducing development costs and time.

Lean blow out-limit, ignition and altitude relight will be investigated. The airflow distribution and the aero-design of prediffusers for lean low NOx combustion with up to 70% air consumption will be optimised.



Wall temperature prediction and testing for a highly efficient cooling design will be performed.

An assessment of generated knowledge and implementation in the knowledge-based system will take place.

Expected Results

The new lean burn concepts have to gain customer and market acceptance to be fully competitive. The answers to principal questions concerning the operability and airworthiness of low NOx combustors will be given.

Acronym:	INTELLECT D.M.	
Contract:	AST3 - CT - 2003 – 502961	
Instrument:	Specific Targeted Research Project	
Total Budget:	€7 737 100	
EC Contribution:	€5 000 200	
Starting Date:	01/01/2004	
Duration:	48 months	
Website:	www.intellect-dm.org	
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	Technical University of Czestochowa	PL
	SAFRAN S.A.	FR
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	Università degli Studi di Firenze	IT
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	Loughborough University	UK
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	University of Cambridge	UK
	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (CERFACS)	FR
	Universität Karlsruhe (Technische Hochschule)	DE
	Centre National de la Recherche Scientifique (CNRS)	FR

TLC

Towards Lean Combustion

Background

The mitigation of aviation emissions, in terms of their environmental impact, is a priority for both air quality (local impact) and the greenhouse effect (global impact). The main margin for progress is in the field of combustor technology. Lean combustion technology is the breakthrough that should enable high-level reductions in NOx emissions, both at airports and in cruise. In addition, lean combustion also assists the reduction of particulates. Injection systems are the most critical issue in achieving a satisfactory level of lean combustion, and are the focus of this project.

Project objectives

The project aims to achieve sufficient maturity in lean combustion for the single annular combustor application. The objectives will be an 80% reduction in NOx emissions in relation to the CAEP2 regulation limit during the LTO (Landing and Take-Off) cycle, and low NOx emission indices at cruise speed (EINOx=5g/kg as a target). Other gaseous emissions and soot performance characteristics will also be precisely evaluated. In addition, significant progress is expected on non-intrusive measurements and numerical diagnostics.

Description of the work

A wide range of experiments will be carried out on mono-sector or tubular combustors. The injection systems tested will be of LPP/LP (Lean Premixed Prevaporised/Mean Premixed) type, derived from the LOPOCOTEP 5th Framework Programme project or other projects, and from advanced CFD optimisation of new concepts. The entire range of operating conditions will be experimentally evaluated (LTO points, cruise speeds). Auto-ignition and flashback risk issues as well as lean extinction limits will be assessed.

The project will support, in parallel, the adaptation of advanced, non-intrusive laser-based measurement techniques to combustor actual conditions and their application (in addition to intrusive techniques) to experiments of the various concepts of injection systems. Advanced CFD simulation will also exploit the data from the fundamental experiments, thereby enabling calibration of the latest codes in emission predictions.

The project is composed of four Work Packages: on non-intrusive measurements, including in particular LIF, CARS, LDA/PDPA and LII techniques; on experimental campaigns to assess new LPP/LP injection systems performance; on injection systems designs and optimisation; on numerical exploitation (RANS and LES) and diagnostics.

Expected results

The project will result in the achievement of satisfactory maturity on lean injection systems with high pollutant level reduction, the development of appropriate non-intrusive laser-based measurement techniques, the calibration of the most modern CFD tools and the establishment of rigorous optimisation procedures for lean injection systems.

Acronym:	TLC	
Contract No.:	AST4-CT2005-012326	
Instrument:	Specific Targeted Research Project	
Total Cost:	€7 551 905	
EU Contribution:	€5 099 945	
Starting Date:	01/03/2005	
Duration:	48 months	
Website:	www.TLC.com (not yet created)	
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	AVIO S.p.A.	IT
	Turbomeca S.A.	FR
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	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Lunds Universitet	SE
	Centre National de la Recherche Scientifique (CNRS)	FR
	Ecole Centrale de Nantes	FR
	Universität Karlsruhe (Technische Hochschule)	DE
	Università degli Studi di Genova	IT
	Università di Napoli "Frederico II"	IT
	Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (CERFACS)	FR
	Fundación Empresa Universidad de Zaragoza	ES
	Università degli Studi di Roma "La Sapienza"	IT
	Instytut Maszyn Przeplywowych im. Roberta Swewalskiego Polskiej Akademii Nauk	PL
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VITAL

Environmentally Friendly Aero-Engine

Background

As the Kyoto Protocol comes into force in 2005, requiring developed countries to reduce their CO_2 emissions and prioritise the environment, VITAL is looking into significantly reducing noise, fuel use and polluting emissions from aircraft. This aim falls within the ambitions of the ACARE, which has set two goals addressed by VITAL for 2020: cutting in half both perceived aircraft noise and CO_2 emissions. VITAL works along the same lines and complements two EU projects funded under the 5th Framework Programme, EEFAE and SILENCE(R).

Project objectives

VITAL will provide a major advance in developing the next generation commercial aircraft engine technologies, enabling the European aero-engine industry to produce high–performance, low-noise and low-emission engines at an affordable cost for the benefit of their customers, air passengers and society at large.

The main objective of VITAL is to develop and validate engine technologies that will provide:

- 6 dB noise reduction per aircraft operation and equivalent to a cumulative margin of 15-18 EPNdB on the three certification measurement points
- 7% reduction in CO_2 emissions.

This is with regard to engines in service prior to 2000.

VITAL will integrate the benefits and the results of on-going research projects with regard to weight reduction (EEFAE) and noise reduction (SILENCE(R)) technologies, assess at a whole engine level their benefits and combine their outcomes with those of VITAL to enable, by the end of the project in 2008, the following:

- 8 dB Noise reduction per aircraft operation (cumulative ~24 EPNdB on the 3 certification measurement points)
- 18% reduction in CO_2 emissions.

Description of the work

The objective of VITAL will be achieved through the design, manufacture and rig-scale testing of the following innovative technologies and architectures:

- two innovative low-speed fan architectures for:
  - Direct Drive Turbo Fan (DDTF) and Geared Turbo Fan (GTF)
  - Contra-Rotating Turbo Fan (CRTF)

  This will include intensive use of lightweight materials to minimise the weight penalty of Very High Bypass Ratio (VHBR) engines.
- new high-speed and low-pressure compressor concepts and technologies for weight and size reduction
- new lightweight structures using new materials as well as innovative structural design and manufacturing techniques
- new shaft technologies enabling the high torque needed by the new fan concepts through the development of innovative materials and concepts
- new low-pressure turbine technologies for weight and noise reduction, suited to any of the new fan concepts
- optimal installation of VHBR engines related to nozzle, nacelle, reverser and positioning to optimise weight, noise and fuel burn reductions.

All these technologies will be evaluated through preliminary engine studies for the three architectures, DDTF, GTF and CRTF.

To achieve the VITAL objectives, different modules of an engine have been considered, some being generic and usable in all three engine types, while some others are specific. Consequently, the work in VITAL is organised into seven technical sub-projects and a sub- project (Sub-Project 0) for management and dissemination activities. The technical sub-projects are split according to each part of the engine. A transversal sub-project (Sub Project 1) ensures the modules' good integration by:

– defining module requirements
– assessing the three main engine architectures: DDTF, GTF and CRTF.

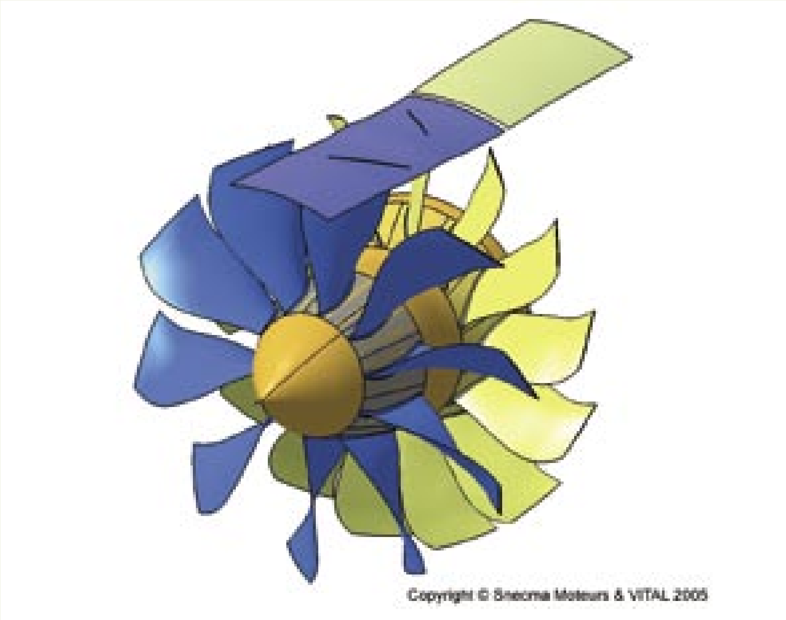
VITAL will research, design and develop technologies regarding:

– innovative fan design (lightweight fan and contra fan technologies) – Sub Project 2
– high-load booster design and technologies – Sub Project 3
– lightweight hot and cold structures – Sub Project 4
– novel materials and concept for low-pressure engine shafts – Sub Project 5
– high-loaded and high-lift low noise and lightweight, low-pressure turbines – Sub Project 6
– nacelle design and aircraft installation– Sub Project 7.

Expected results

VITAL will result in the validation of the consortium's capability of producing innovative VHBR engine architectures. This will be carried out via design, manufacture and rig tests on engine modules. Specific project results will be:

– two fully instrumented fans (DDTF & CRTF)
– a fan rotor, a fan casing and a structural fan stator
– two low-pressure compressor boosters (low-speed and high-speed)



Schematic of a Contra-Rotating Turbo Fan, one of the three Very High By-Pass Ratio engine architectures to be studied as part the VITAL Integrated Project.

- new lightweight materials and material forms (polymer matrix composites and titanium)
- composite high torque shafts
- turbines for DDTF/GTF applications
- nozzle installation under the wing
- guidelines for the development of 2020 engines.

Acronym:	VITAL
Contract No.:	VITAL AIP4-CT-2004-012271
Instrument:	Integrated Project
Total Cost:	€90 486 049
EU Contribution:	€50 490 000
Starting Date:	01/01/2005
Duration:	48 months
Website:	www.projectvital.org
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	National Research & Development Institute for Turboengines Comoti R.A.	RO
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	Fundación Centro de Tecnologías Aeronáuticas	ES
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	EAST-4D GmbH Lightweight Structures	DE
	Fischer Advanced Composite Components AG	AT
	Swedish Defence Research Agency (FOI)	SE
	FORCE Technology	DK
	GKN Aerospace Services Ltd.	UK
	Global Design Technology	BE
	Technische Universität Graz	AT
	Hurel-Hispano	FR

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Photon Laser Engineering GmbH	DE
Politecnico di Torino	IT
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Short Brothers plc	UK
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Università degli Studi di Firenze	IT
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Universität der Bundeswehr München	DE
Universidad Politécnica de Madrid	ES
Vibratec	FR
Von Karman Institute for Fluid Dynamics (VKI)	BE
Volvo Aero Corporation AB	SE
Volvo Aero Norge A.S.	NO
Wytwornia Sprzetu Komunikacyjnego "PZL-Rzeszow" S.A.	PL

CoJeN

Computation of Coaxial Jet Noise

Background

Despite the progress in the development of CFD solvers, most of the jet noise prediction methods currently in use in the aerospace industry are correlations based on empirical databases. Significant advances have recently been made towards developing aero-acoustic methods, which use CFD results as the input for prediction of the acoustic fields generated by exhaust flows. However, these studies have concentrated mainly on fundamental cases, such as single-stream jets. The industrial requirement is to predict the noise from complex geometries, such as coaxial jets with pylons, forced mixers and serrated nozzles.

Project objectives

The principle objective of CoJeN is:

- To develop and validate prediction tools, which can be used by the aerospace industry to assess and optimise jet-noise reduction techniques.

In order to bring the methods developed in JEAN (a Framework Programme 5 project) and the national programmes to the point where they are useful to industry, the methods must be extended to cope with hot coaxial jets and arbitrary nozzle geometries. The methods must also be validated to demonstrate their accuracy and reliability.

Accordingly, the specific technical objectives of the project are:

- To identify and improve optimal CFD techniques for the prediction of jet flow development from coaxial nozzles of arbitrary geometry
- To develop aero-acoustic codes, which can predict the acoustic fields from the CFD results
- To acquire aerodynamic and acoustic data with which to validate these codes.

Description of the work

In CoJeN, CFD techniques for the prediction of the turbulence characteristics of coaxial jets are being developed and validated. These will be linked to noise source generation and propagation models for the prediction of the near- and far-field noise. The results from these will be critically evaluated against data, which will be obtained from a series of carefully designed experiments. The project is divided into the following Work Packages and tasks:

Project management, specifications and assessment

Flow prediction
- Reynolds Averaged Navier-Stokes (RANS) techniques
- Large eddy simulation (LES) and detached eddy simulation (DES) techniques
- Vortex methods
- Technology transfer

Acoustic source generation and propagation modelling
- Acoustic analogies
- Direct methods
- Hybrid methods
- Technology transfer

Acquisition of validation data
- Advanced measurement techniques
- Single and multi-point flow measurements
- Whole field flow measurements
- Acoustic measurements
- Testing and data reduction.

Expected results

1) Validation of efficient flow solvers for coaxial jet development.
2) Integration of these to updated classical and novel source and propagation models.
3) Prediction methodologies for jet noise applications.
4) Measurement of turbulent length scales in jets as a function of frequency.

5) Further development of new methods for the identification of aero-acoustic source mechanisms using the multi-point measurements.

6) Use of new signal processing techniques for turbulence/acoustic measurements.

Acronym:	CoJeN
Contract No.:	AST3-CT-2003-502790
Instrument:	Specific Targeted Research Project
Total Cost:	€5 691 810
EU Contribution:	€3 700 000
Starting Date:	01/02/2004
Duration:	36 months
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Volvo Aero Corporation AB	SE
Dassault Aviation S.A.	FR
Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
National Research & Development Institute for Turboengines Comoti R.A.	RO
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
Chalmers Tekniska Högskola AB	SE
Ecole Centrale de Lyon	FR
Trinity College Dublin	IE
University of Southampton	UK
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Universidad Politécnica de Madrid	ES
Technische Universität Berlin (TUB)	DE
Rheinisch-Westfälische Technische Hochschule Aachen	DE
University of Bath	UK
Centrale Lyon Innovation	FR
Université de Poitiers	FR

FRIENDCOPTER

Integration of Technologies in Support of a Passenger and Environmentally Friendly Helicopter

Background

Today's helicopters need to be improved further to gain more environmental and public acceptance. Helicopters generate external noise, cabin noise and vibration due to the complex nature of their dynamic systems and suffer from NOx emissions, like other transport systems. It is therefore essential that these issues are addressed to improve the situation for new generation rotorcraft, to make them environmentally friendly and acceptable to the general public.

Project Objectives

- Acoustic footprint areas reduced between 30% and 50% depending on the flight condition.
- A reduction of up to 6% of fuel consumption for high-speed flight.
- Cabin noise levels below 75 dBA, similar to airliner cabins for normal cruise flight.
- Cabin vibrations below 0,05 g corresponding to jet smooth ride comfort for the same flight regime.

Description of the work

In the area of short-term objectives:

1) Noise Abatement Flight Procedure

As a short-term goal of external noise reduction, the impulsive noise (blade slap noise) during the particularly sensitive approach phase will be tackled by dedicated flight procedures, which also take into account aspects of safety and certification. The goal is to identify a combination of glide path angle and flight speed to circumvent the area of high blade slap. The procedures will be demonstrated in-flight by different helicopter types and will be introduced as extensively as possible into the respective flight manuals. A microphone array will record noise footprints to measure significant noise annoyance. To optimise this method, a common noise footprint prediction tool will be established, based on the partners' existing codes.

2) Cabin Noise Reduction

The reduction of the cabin noise level will be addressed in a twofold way:

A. by tackling cabin noise emission at the source:

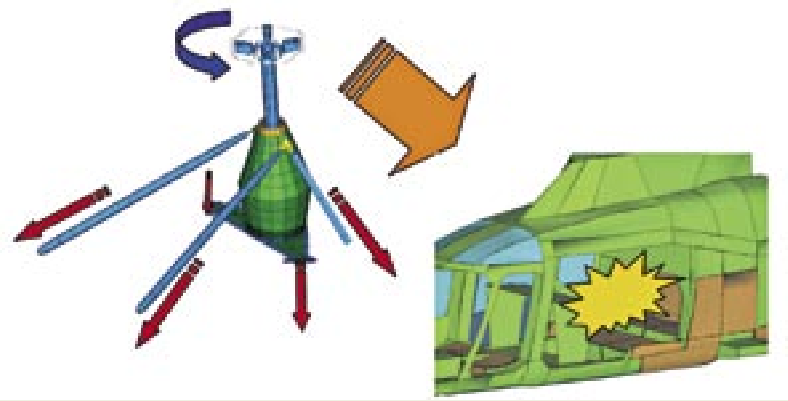
In order to favourably influence the emission characteristics of the gearbox, main gearbox elements will be modified and damping features will be added. In addition, at the interfaces between gearbox and fuselage, active elements will be implemented to interrupt the transmission of structure-born noise. Dedicated rig- and flight-tests are planned.

B. by reducing cabin noise in the cabin itself:

Applying active structure control, mainly acting on cabin panelling, will reduce structural and aerodynamic noise. In order to focus the cabin treatment measures on critical areas, methodologies to identify acoustic leaks will be developed. Identification technology and effectiveness of the cabin treatment will be verified by flight-testing.

3) Engine Noise Reduction

The engine noise emission will be tackled by acoustically treating the engine inlet and outlet ducts with noise absorbing structures. The lessons learnt from the Fifth Framework Programme HORTIA



Reduction of internal and external noise

project will be used among others. In this project, first attempts to treat the engine outlet acoustically have been started. After a dedicated concept study, bench- and flight-tests will prove the efficiency of the actions taken.

In the area of long-term objectives:

4) Active Blade Control

In order to accomplish in the long term:

- larger noise reductions
- lower NOx emissions
- minimised cabin vibrations.

the technology of active blade control (ABC) through actuation distributed along the blade surface will be brought to maturity and validated. This technology will allow:

- blowing away the blade tip vortices responsible for the blade slap noise
- use of thin blade tips but with delayed flow separation through high blade incidence angles leading to a lower power requirement
- generation of secondary excitation loads counteracting the original unsteady forces and moments at the rotor hub.

For this reason, distributed piezo-ceramic actuators will be integrated into the rotor blade skin, generating dynamic blade twist and camber adapted to the flight condition at any given time.

In detail, tests will be carried out on:

- the integration aspect by blade rig-tests of full scale blade segments
- the controllability of the rotor blades through a Mach-scaled model rotor in hover conditions.

These tests will represent a decision point for continuation in the form of intensive wind tunnel- and subsequently also flight-tests planned for the Seventh Framework Programme.

Expected results

The activities envisaged are to provide a number of key deliverables. All of these will have undergone intense efficiency testing, mostly by flight tests. They will consist of the following:

- for Noise Abatement Flight Procedures:
  - flight guidelines/flight manuals enabling helicopter pilots to perform noise abatement flight procedures
  - a software tool, to be used by helicopter designers, local heliport authorities as well as noise certifying authorities, and even architects, to predict the noise around heliports.
- for Engine Noise Reduction:
  - design proposals for appropriate inlet and outlet geometries
  - liners for quiet air intakes and exhaust nozzles
  - recommendations for airworthiness and performance aspects.
- for Cabin Noise Reduction:

- acoustic leak detection methods
  - a quiet main gearbox
  - an active reduction of structure-borne gearbox noise
  - actively and passively-damped cabin trim panels.
- for Rotor Noise Control:
  - an experimentally validated technology for an active reduction of noise, vibrations and fuel consumption
  - a proof of blade controllability by model rotor blade spin tests
  - evidence of actuator endurance and integration appropriateness by full-scale blade sample tests.

Acronym:	FRIENDCOPTER
Contract No.:	AIP3-CT-2003-502773
Instrument:	Integrated project
Total Cost:	€32 488 498
EU Contribution:	€18 277 908
Starting Date:	01/03/2004
Duration:	54 months
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	ANOTEC Consulting, S.L.	ES
	Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Daher Lhotellier Aerotechnologies	FR
	EADS Deutschland GmbH	DE
	Eurocopter S.A.S.	FR
	Free Field Technologies S.A.	BE
	Formtech GmbH	DE
	Gamesa Desarrollos Aeronauticos S.A.	ES
	ARCELLES SAS	FR
	Ingenieria Y Economia del Transporte S.A. (INECO)	ES
	Instituto de Soldadura e Qualidade (ISQ)	ES
	Ingenieria de Sistemas para la Defensa de Enpaña S.A. (ISDEFE)	ES
	Leuven Measurements and Systems International NV	BE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Noliac A/S	DK
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Wytwornia Sprzetu Komunikacyjnego «PZL-Swidnik» S.A.	PL

Turbomeca S.A.	FR
Vyzkumny a Zkusebni Letecky Ustav, A.S. (VZLU)	CZ
Westland Helicopters Ltd.	UK
ZF Luftfahrttechnik GmbH	DE
Cranfield University	UK
Instituto Superior Técnico (IST)	PT
Kungliga Tekniska Högskolan (KTH)	SE
Politecnico di Milano	IT
Carl von Ossietzky Universität Oldenburg	DE
University of Patras	EL
Riga Technical University	LV
Università degli Studi Roma Tre	IT
Paulstra S.N.C.	FR

MESSIAEN

Methods for the Efficient Simulation of Aircraft Engine Noise

Background

Aircraft noise is a major environmental and societal problem, and aircraft engine noise is currently the most prominent noise source. Noise generation by aircraft engines and propagation from the engine to a receiver (control microphone or citizen) is a complex process. To assess possible solutions, the industry requires accurate and flexible simulation tools able to predict the noise generated by a given engine and to compare, both critically and objectively, the efficiency of different quietening solutions.

Project Objectives

Aircraft engine noise consists of various contributions: fan, compressor, turbine and jet noise. Fan noise is then separated further into forward (inlet) and rearward (exhaust) noise components. Simulation techniques now exist for fan forward noise propagation and radiation, for instance those developed in the earlier AROMA 5th Framework Programme project. These techniques are, however, limited in performance (especially for 3D geometries at mid to high frequencies). Moreover, exhaust fan noise raises specific questions, notably on the propagation of noise disturbances through shear layers generated by the coaxial jets behind the engine. MESSIAEN will target the development of new methods designed to meet these specific challenges.

The chosen method is based on the solution of linearised Euler equations (LEE) using discontinuous Galerkin methods (DGM). The objectives of MESSIAEN, expressed in terms of accuracy, performance and robustness, are based on specifications drawn by the industrial members of the consortium.

Description of the work

The work programme consists of six related Work Packages:

Work Package 1 defines the expectations of the industrial end-users in terms of applicability and performance. Detailed specifications were drawn for each targeted application: aircraft engine (from the standpoint of the air-framer, engine and nacelle manufacturers), turbo-shaft engine nozzle, air system and axial compressor.

Work Package 2 works on source modelling and on the recovery of computational fluid dynamics (CFD) results for source quantification. Noise is generated by the flow through the fan, which is calculated by dedicated CFD tools. Work Package 2 considers both the physical and mathematical aspects related to noise generation but also the data interfacing aspects.

Work Package 3 investigates sound propagation in the near field of the source including the effect of liners. The method chosen in MESSIAEN is based on the solution of linearised Euler equations (LEE) using discontinuous Galerkin methods (DGM). This time-domain approach raises delicate issues related to the integration of frequency dependent impedance boundary conditions and of modal excitations, which are tackled in specific tasks. Alternative approaches (e.g. pseudo time-stepping) are also investigated.

Work Package 4 looks into the problem of sound radiation in the far field of the source. The DGM method only models the near field, and specific techniques like the Ffowcs-Williams and Hawkings method need to be implemented. An analytical approach (TEARS) and a simplified approach specifically tailored to air systems are also developed within Work Package 4.

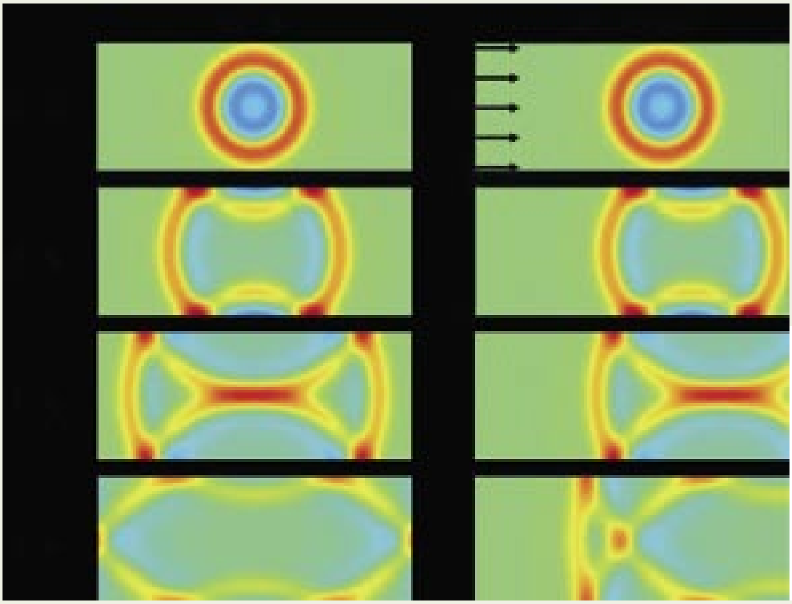
Work Package 5 applies the developments to end-user applications: engine nacelle/bypass/exhaust applications, turbo-shaft engine nozzle applications, air systems applications and axial compressor applications.

Work Package 6 is concerned with project management, dissemination and exploitation.

Expected results

MESSIAEN will have a real impact in reinforcing competitiveness in the European aerospace industry. Significant cost and time benefits will follow from the ability to rely on computational methods rather than experimental tests in the design and verification activity of engine development programmes.

The MESSIAEN software will be commercially exploited by the coordinator, FFT, while other partner SMEs will enlarge their engineering services by including turbo-machinery noise design activities.



Work Package 3 studies sound propagation in a moving fluid. The image shows successive wave fronts generated by an acoustic point source radiating in a duct with uniform mean flow

Acronym:	MESSIAEN	
Contract No.:	AST3-CT2003-502938	
Instrument:	Specific targeted Research Project	
Total Cost:	€2 450 177	
EU Contribution:	€1 594 427	
Starting Date:	01/12/2003	
Duration:	30 months	
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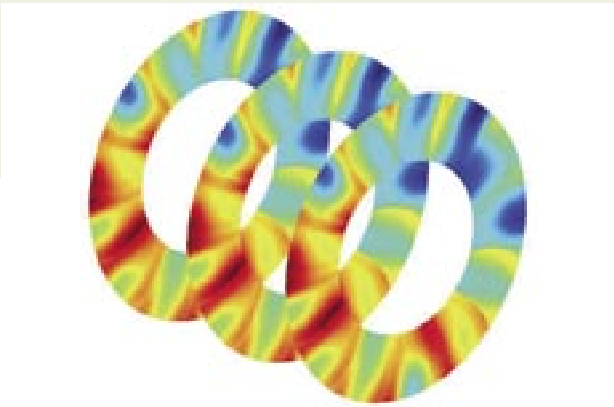
	University of Southampton	UK
	Liebherr Aerospace Toulouse S.A.	FR
	Rolls-Royce plc	UK
	Technische Universiteit Eindhoven	NL
	Turbomeca S.A.	FR
	Université Catholique de Louvain	BE
	Vibratec	FR
	Ødegaard & Danneskiold-Samsøe A/S	DK



In Work Package 2, sound sources are calculated from pressure distribution calculated in three closely spaced sections just upstream of downstream the fan

HISAC

Environmentally Friendly High-Speed Aircraft

Background

Many projects carried out in Europe and elsewhere have addressed the large supersonic transport aircraft market. However, up until now, none has yielded substantial results due to difficulties in overcoming economic and environmental issues. But beyond the current market for small subsonic aircraft, there is a substantial segment of customers interested in flight time being reduced by 20 to 50% compared to current subsonic business aircraft on distances over 6 500 km, which is the minimum required for transatlantic flights.

Project objectives

The impeding factors are strongly mitigated by reducing the size of the aircraft. The HISAC project therefore aims to establish the technical feasibility of an environmentally compliant small-size supersonic transport aircraft (S4TA), through a multi-disciplinary optimisation (MDO) approach and focused technological improvements.

The first general objective is to identify the characteristics of aircraft that could meet prospective environmental requirements, namely:

- reduction of external noise by an 8 dB cumulative margin re ICAO Chapter 4
- NOX emissions: less than 5g per kg fuel burnt in the long term, 10g in the medium term
- emissions at landing and take-off comparable to those of a subsonic aircraft
- reduction of the sonic boom signature overland, while offering attractive performance to the customer
- flight time reduction from 20 to 50% compared to current aircraft
- range that is at least transatlantic
- operative from small airports
- cabin suitable for 8 to 16 passengers.

The second objective is to provide policymakers with a set of recommendations for future environmental regulations, which could reasonably be met with an optimised S4TA.

As a third objective, HISAC will provide progress on critical elementary technologies, associated design and multidisciplinary optimisation methods, as well as a plan for further research.

Description of the work

Based on their experience, the HISAC partners have chosen the following path:

- Translation of the environmental objectives into quantified design criteria for community noise, atmospheric emissions, and sonic boom, applicable to an S4TA;
- Adaptation of numerical models and tools essential to the multidisciplinary design process. Emphasis will be put on noise, emissions, sonic boom, propulsion and aerodynamics, as well on the MDO process itself;
- Development and validation of the most critical engine and airframe technologies. Technologies considered will be variable cycle and nozzle noise reduction for engines, forced laminar flow, high-lift devices and variable geometry wings for the airframe; mixer-ejector nozzles will be designed and tested for a better assessment of this engine technology;
- Establishment of rules and methods to solve key integration issues. For this purpose specific shape design work, supported by wind tunnel tests, will be performed, focusing on engine

integration (this will be a compromise between low noise and low drag), boom minimisation, and maximisation of transition delay. Specific airworthiness issues will also be overviewed in order to identify the key points of the future specific conditions for certification;
- Application of MDO methods, using the results of the above, to obtain:
  - aircraft specifications compliant with environmental objectives. To explore the broadest range of concepts and address all design and environmental issues, the work will be shared between the partners with three aircraft configuration teams;
  - quantified trade-offs between aircraft performance and environmental constraints.

Expected achievements

HISAC will provide:

- achievable specifications for an environmentally compliant and economically viable small-size supersonic transport aircraft
- recommendations for future supersonic environmental regulations (community noise, emissions, sonic boom)
- enabling technologies and a road-map for their further maturation and validation, up to a future Proof Of Concept.

Acronym:	HISAC
Contract No.:	AIP4-516132
Instrument:	Integrated Project
Total Cost:	€26 063 718
EU Contribution:	€14 246 624
Starting Date:	01/05/2005
Duration:	48 months
Website:	http://www.hisacproject.com
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Partners:	Dassault Aviation S.A.	FR
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	CFS Engineering SA	CH
	EADS Deutschland GmbH - Military Aircraft	DE
	Rolls-Royce plc	UK
	RUAG Aerospace	CH
	Sukhoi Civil Aircraft	RU
	SENER Ingeniería y Sistemas S.A.	ES
	SAFRAN S.A.	FR
	SONACA S.A.	BE
	Volvo Aero Corporation AB	SE
	Aircraft Development and Systems Engineering B.V. (ADSE)	NL
	Engin Soft Tecnologie per l'Ottimizzazione s.r.l. (ESTECO)	IT
	IBK Ingenieurbüro Dr. Kretschmar	DE
	Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
	Numerical Mechanics Applications International S.A. (NUMECA)	BE
	Aircraft Research Association Ltd.	UK
	Central Institute of Aviation Motors (CIAM)	RU
	Centre National de la Recherche Scientifique (CNRS)	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Swedish Defence Research Agency (FOI)	SE
	Institut National de Recherche en Informatique et en Automatique (INRIA)	FR
	Institute of Aviation Warsawa (IoA)	PL
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Central Aerohydrodynamic Institute (TsAGI)	RU
	Eurocontrol - European Organisation for the Safety of Air Navigation	INT
	Chalmers Tekniska Högskola AB	SE
	Cranfield University	UK
	Ecole Centrale de Lyon	FR
	Ecole Polytechnique Fédérale de Lausanne	CH
	Ecole Polytechnique Fédérale de Lausanne	CH
	University of Southampton	UK
	Kungliga Tekniska Högskolan (KTH)	SE
	National Technical University of Athens (NTUA)	EL
	Trinity College Dublin	IE
	Università di Napoli "Frederico II"	IT
	Institute of Theoretical and Applied Mechanics (ITAM)	RU

PROBAND

Improvement of Fan Broadband Noise Prediction: Experimental Investigation and Computational Modelling

Background

Fan broadband noise is a major aircraft noise challenge now and will be even more important in the future. Novel low-noise engine architectures, such as ultra-high-bypass-ratio engines and lower-speed fans, can help address jet noise and fan tone noise, but they are unlikely to reduce fan broadband noise significantly. The accurate prediction and control of fan broadband noise is therefore essential if aircraft noise is to be reduced.

The most significant broadband noise sources are believed to be generated by the different interaction mechanisms between:

1. the blade tip vortex of the rotor fan and the turbulent boundary layer on the inlet-duct (rotor boundary layer interaction noise)
2. turbulent eddies convected in the rotor boundary layer past the rotor trailing edge (rotor self noise)
3. the impingement of the rotor wake onto the downstream outlet guide vanes (OGV interaction noise)
4. turbulent eddies convected in the vane boundary layer and the vane trailing edge (OGV self noise).

These four mechanisms each generate a whole spectrum of frequencies, making it difficult to use conventional noise measurements to isolate the contribution of each mechanism. Furthermore, the broadband noise generation process is very complex to model, requiring representation of the fine length scales involved in turbulence generation and propagation. Consequently, current methods for industrial broadband noise prediction are almost exclusively semi-analytic in nature. They rely largely on correlating measured noise levels to a few relevant aerodynamic and geometric parameters, but are unable to predict the effects of different blade geometries. The advances in purely numerical methods, which have revolutionised tone noise prediction, have yet to make an equivalent impact on broadband noise prediction.

Project objectives

The objective of PROBAND is to develop methods to allow the design of a fan system that will generate sufficiently low broadband noise to meet the EU noise level targets. This will be achieved by:

1. developing a better understanding of broadband noise generation mechanisms using advanced experimental and computational techniques
2. developing and validating improved prediction methods using conventional computational fluid dynamics, and integrating them into industrial codes
3. exploring new prediction strategies using advanced computational techniques
4. developing low broadband fan noise concepts.

Description of the work

The main goals of the PROBAND research programme are to be achieved by:

– developing coupled RANS/semi-analytic models for fan stage broadband noise sources and validating these

- models against representative fan rig measurements
- developing and evaluating the application of advanced CFD methods based on LES and DES and demonstrating their potential application for industrial fan stage noise assessment
- promoting an increased understanding of turbulence-driven, broadband noise generation in aero-engine fan stages through detailed measurement of turbulence structure and noise on representative configurations
- developing concepts for low-broadband noise fan stage configurations by exploiting the project numerical and experimental results.

Expected results

PROBAND will enable improved physical understanding of the source mechanisms of self-noise, interaction noise, and tip clearance noise. The fundamental experiments will provide, in conjunction with advanced CFD, a deeper insight into the flow physics in the source regions. PROBAND will develop new tools allowing large scale advanced CFD, and will validate them in a realistic experimental environment. PROBAND will deliver an improved prediction capability for broadband noise that will be exploited by the European engine industry to develop low broadband noise fan concepts. The final goal of PROBAND is to develop the methods that will enable the design of a fan with sufficiently low broadband noise to allow the EU Sixth Framework Programme's short-term and long-term objectives of reducing aircraft external noise by 4-5 dB and by 10 dB respectively to be achieved.

Acronym:	PROBAND	
Contract No.:	AST4-CT-2005-012222	
Instrument:	Specific Targeted Research Project	
Total Cost:	€4 821 914	
EU Contribution:	€3 000 000	
Starting Date:	01/04/2005	
Duration:	36 months	
Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR) Institute of Propulsion Technology Turbulence Research Division Müller-Breslau-Str. 8 DE-10623 Berlin	
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Partners:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Rolls-Royce plc	UK
	SAFRAN S.A.	FR
	Ecole Centrale de Lyon	FR
	Fluorem S.A.S.	FR
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Université Pierre et Marie Curie	FR

University of Southampton	UK
University of Cambridge	UK
Technische Universität Berlin (TUB)	DE
Von Karman Institute for Fluid Dynamics (VKI)	BE
Università degli Studi Roma Tre	IT
Kungliga Tekniska Högskolan (KTH)	SE
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Centrale Lyon Innovation	FR
ANECOM AEROTEST GmbH	DE

SEFA

Sound Engineering for Aircraft

Background

SEFA is the first project using sound engineering practices to define optimum aircraft noise shapes (target sounds). It is a unique and innovative approach for exterior aircraft noise control as it considers human factors as well as technical factors.

Project objectives

The project objectives are:

- To establish scientifically how the noise annoyance of aircraft can be reduced, not just by lowering noise levels but also by improving the characteristics of aircraft noise signatures.
- To develop optimum aircraft noise shapes based on a sound quality approach, together with simulation tools capable of adjusting to future technology developments and improvements in the understanding of noise impact.
- To use these findings and tools in setting up sound engineering design criteria for optimum exploitation of novel noise reduction technologies, innovative aircraft and engine architectures, and extended operational capabilities.

Description of the work

Aiming at the development of sound engineering design criteria for future aircraft, the project will go through successive phases that can be summarily described as specification (Work Package 1), understanding (Work Package 2), optimisation (Work Packages 3-5) and definition of design criteria (Work Package 6).

Work Package 2 is hereby playing a major role in performing the required listening tests. The test results are providing baseline information for the design of an optimised target sound and the formulation of the related design criteria for aircraft.

On top of the Work Package 2 tests, Work Package 5 is analysing the notion of annoyance and its links to aircraft noise and is developing a tool simulating the subjective perception of residents regarding aircraft noise.

Work Package 3 is analysing current aircraft sound shapes and generating optimised target sounds. These target sounds are validated again by psychometric tests (Work Package 2).

Work Package 4 is analysing the aircraft sound shapes with respect to individual source characteristics and is developing a tool, which provides audible sound tracks for virtual aircraft configurations. This tool will provide a feedback loop from the optimised target sounds to the aircraft sources and flight procedures. It will be applied by Work Package 6 in the final definition of design criteria for aircraft.

Expected results

The major output of the programme is the definition of aircraft design criteria based on a validated target sound design procedure. In addition, SEFA will provide the valuable assessment of the human-specified characteristics of aircraft sounds by analytical and statistical methods, as well as a basic tool providing audible fly-over sounds for virtual aircraft configurations.

Acronym:	SEFA
Contract No.:	AST-CT-2003-502865
Instrument:	Specific Targeted Research Project
Total Costs:	€5 929 847
EU Contribution:	€3 897 342
Starting Date:	01/02/2004
Duration:	36 months
Web site:	https://cms.x-noise.net/sefa/Portal/ (members only)
Coordinator:	Dornier GmbH Dept. Vibroacoustics DE-88090 Friedrichshafen
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Partners:		
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	SASS Acoustic Research & Design GmbH	DE
	Metravib RDS	FR
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	University of Southampton	UK
	Kungliga Tekniska Högskolan (KTH)	SE
	Alenia Aeronautica S.p.A.	IT
	Forschungsgesellschaft für Arbeitsphysiologie und Arbeitsschutz e.V. (IFADO)	DE
	Budapesti Műszaki és Gazdaságtudományi Egyetem (BME)	HU
	Università degli Studi Roma Tre	IT
	Instituto Superior Técnico (IST)	PT
	EADS Deutschland GmbH	DE
	Université de Cergy Pontoise	FR
	Institut National de Recherche sur les Transports et leur Securité	FR
	Leuven Measurements and Systems International NV	BE
	Centro Ricerche FIAT S.C.p.A.	IT
	Institut für Technische und Angewandte Physik GmbH	DE
	Università di Napoli 'Federico II'	IT

TURNEX

Turbomachinery Noise Radiation through the Engine Exhaust

Background

Research is needed to develop innovative concepts and enabling technologies to reduce aeroengine noise at its source. Turbomachinery noise radiating from the bypass and core nozzles is becoming the dominant noise source on modern aircraft, but, while recent EU research programmes have made significant progress in reducing both the generation of turbomachinery noise and the radiation of noise from the intake, little work has been conducted on reducing the radiation of turbomachinery noise from exhaust nozzles. TURNEX will address this shortfall by delivering improved understanding and validated design methods, and by evaluating a number of low-noise exhaust nozzle configurations aimed at a source noise reduction of 2-3dB.

Project objectives

1. To test, through experiments at model scale, innovative noise reduction concepts and conventional engine exhaust configurations, which utilise novel simulated turbomachinery noise sources and innovative measurement techniques.
2. To improve computational prediction methods for turbomachinery noise radiation through the engine exhaust, and to validate these methods with experimental data.
3. To conduct a parametric study of real geometry/flow effects and noise reduction concepts as applied to current and future aircraft configurations.
4. To assess the relative technical merits of different approaches to testing fan rigs in European noise facilities.

Description of the work

Work Package 1: Turbomachinery noise radiation experiments on an engine exhaust rig in a Jet Noise Test Facility. The main objective is to test at model scale (a) innovative noise reduction concepts, including a scarfed exhaust nozzle, and (b) conventional engine exhaust configurations. The experiments will develop and utilise simulated turbomachinery noise sources and innovative measurement techniques in order to realistically evaluate the noise reduction concepts and to provide a high quality validation database. A secondary objective is to technically assess the relative merits of different methods of estimating far-field noise levels from in-duct and near-field noise measurements, using both models and the validation data, to enhance the capability of European fan noise test facilities to simulate fan noise radiation through the exhaust.

Work Package: 2 Improved Models and Prediction Methods. The objective is to improve models and prediction methods for turbomachinery noise radiation through the engine exhaust, to a level comparable with that being achieved for intake radiation, and validate these with the experimental data.

Work Package: 3 Assessment and Industrial Implementation of Results. The objective is to conduct a parametric study of real geometry/flow effects (pylons, flow-asymmetry) and noise reduction concepts (scarfed nozzles, acoustically lined after-body) as applied to current and future aircraft configurations of interest.

Expected results

TURNEX will deliver validated industry-exploitable methods for predicting turbomachinery noise radiation through exhaust nozzles, allowing European industry to leapfrog NASA-funded technology developments in the US. It will also deliver a technical assessment on the way forward for European fan noise testing facilities and an assessment of exhaust nozzle concepts for noise reduction at source.

Acronym:	TURNEX
Contract No.:	AST4-CT-2004-516079
Instrument:	Specific Targeted Research Project
Total Cost:	€4 695 921
EU Contribution:	€2 899 818
Starting Date:	01/01/2005
Duration:	36 months
Coordinator:	Institute of Sound and Vibration Research (ISVR) University of Southampton Highfield GB-SO17 1BJ Southampton
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Partners:	University of Southampton	UK
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	Dassault Aviation S.A.	FR
	Rolls-Royce Deutschland Ltd. & Co. KG	DE
	Rolls-Royce plc	UK
	Free Field Technologies S.A.	BE
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	EADS Deutschland GmbH	DE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Technische Universiteit Eindhoven	NL
	AVIO S.p.A.	IT
	Middle East Technical University	TR

ASICBA

Aviation Safety Improvement Using Cost Benefit Analysis

Background

Despite the important current efforts on safety data sharing at an international level (for example, the Global Aviation Information Network GAIN, ECCAIRS, etc.), aviation stakeholders proceed, at best, with a limited access to this data because of the lack of adequate tools. The small number of tools available seems to be focusing on data collection rather than data use. Moreover, these tools may be of little practical use, especially in the hectic, budget-tight world of aviation where managers do not seek the time to learn how to exploit these methods fully.

Project objectives

This project aims at the improvement of aviation safety through a novel approach that will allow aviation stakeholders to assess the effects of technical, managerial and political decisions at the safety level, together with the associated costs and benefits. This safety approach will provide the whole spectrum of aviation stakeholders, from EASA to civil aviation authorities, to airlines, airports, air traffic control and manufacturers with the following capabilities:

- to understand and manage the effective risk reduction associated when adopting a safety measure, such as the installation of a device in a cockpit, or the adoption of ground equipment
- to prioritise their investments when multiple options are potentially feasible
- to increase safety as much as possible within the limiting budgets available
- to justify investments in safety from a cost perspective.

Ultimately, applying cost benefit analysis to safety can help demonstrate that safety measures pay, rather than cost money.

Description of work

The safety approach will consist of a methodology enabling aviation stakeholders to assess the effects of their technical, managerial and political decisions at the safety level, together with the associated costs and benefits. The approach will support decisions such as whether or not to introduce a safety measure, by defining priorities for investments in safety, based on the most beneficial outcome. The methodology will be implemented into a Decision Support System (DSS), providing a step-by-step procedure that will support the user throughout the different phases for assessing the cost effectiveness of safety measures. The DSS will incorporate a data pool for the estimation of risk reduction and costs related to the implementation of specific safety measures.

Cost benefit analysis of safety measures is a relatively new concept in the aviation community and decisions on safety related matters are taken without knowing precisely what will be the final effect of such decisions. This project will provide the means for taking decisions at different levels (i.e., policy, procedures and operational level) in order to understand the consequences of safety from the viewpoint of policy-makers and regulators on the one side and industry on the other. While for policy-makers and regulators, the objective is safety with affordability as a requirement, for industry the objective is affordability with safety as a requirement.

The project has been structured into seven Work Packages enabling the achievement of the project objectives. These Work Packages are:

- Work Package 0: Technical and Administrative Coordination

- Work Package 1: State-of-the-art and Users' Needs
- Work Package 2: Functional Requirements
- Work Package 3: Development of a novel Safety Approach
- Work Package 4: Development of Decision Support Tool
- Work Package 5: Application of the novel Safety Approach to Case Studies
- Work Package 6: Dissemination of the Results.

During the project, two series of workshops will be organised, focusing on real case studies, on subjects proposed by users of ASICBA. The objective of having workshops is twofold, namely to support the development of the safety approach in the first instance, and to then validate the approach.

Expected achievements

ASICBA will contribute to the two top priorities identified in the SRA and the Vision 2020 report:

- to meet society's needs for a more efficient, safer and environmentally friendly air transport;
- to win global leadership for European aeronautics, with a competitive supply chain, including small and medium-size enterprises.

The project will also contribute to three of the four research areas listed in the Aeronautics and Space work programme. These areas are:

- strengthening competitiveness
- improving aircraft safety and security
- increasing the operational capacity and safety of the air transport system.

Acronym:	ASICBA	
Contract No.:	AST4-CT-2005-012242	
Instrument:	Specific Targeted Research Project	
Total Cost:	€1 770 094	
EC Contribution:	€944 739	
Starting Date:	15/01/2005	
Duration:	24 months	
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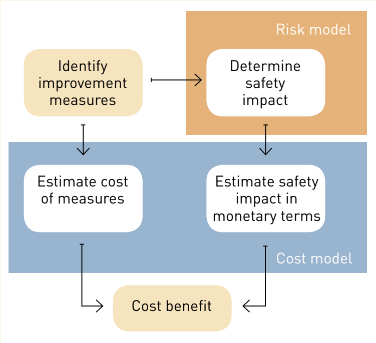
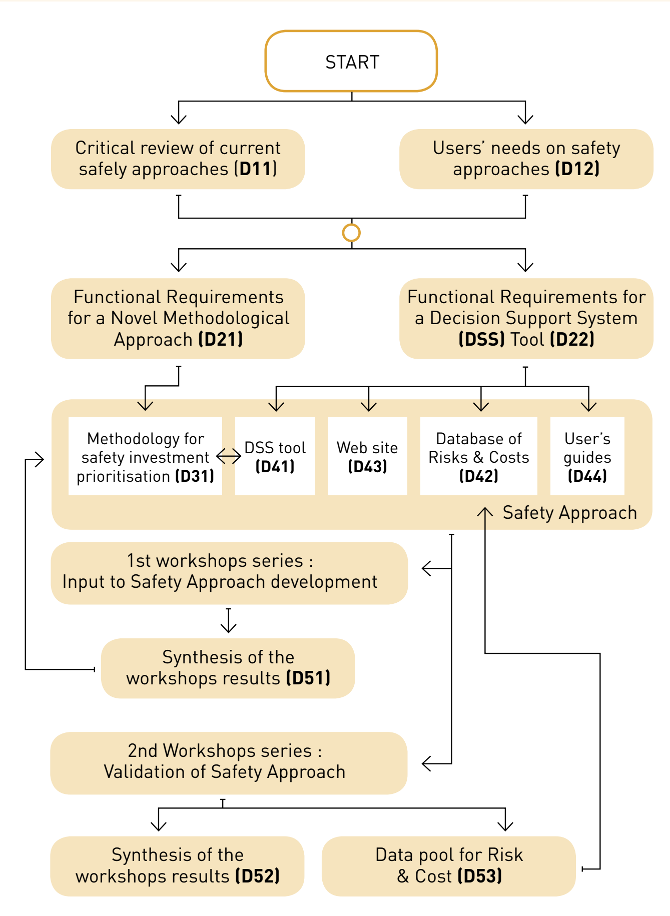
Partners:	D'Appolonia S.p.A.	IT
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Airclaims Ltd.	UK
	ECORYS Nederland B.V.	NL
	Politecnico di Milano	IT
	Meridiana S.p.A.	IT
	Polish Airlines LOT S.A.	PL
	Gestione Aeroporti Sardi S.p.A.	IT



Risk model
Identify improvement measures
Determine safety impact
Estimate cost of measures
Estimate safety impact in monetary terms
Cost model
Cost benefit



START
Critical review of current safely approaches (D11)
Users' needs on safety approaches (D12)
Functional Requirements for a Novel Methodological Approach (D21)
Functional Requirements for a Decision Support System (DSS) Tool (D22)
Methodology for safety investment prioritisation (D31)
DSS tool (D41)
Web site (D43)
Database of Risks & Costs (D42)
User's guides (D44)
Safety Approach
1st workshops series : Input to Safety Approach development
Synthesis of the workshops results (D51)
2nd Workshops series : Validation of Safety Approach
Synthesis of the workshops results (D52)
Data pool for Risk & Cost (D53)

FARE-Wake

Fundamental Research on Aircraft Wake Phenomena

Background

This project is the continuation of a recent effort, on a European level, to characterise, understand and control aircraft wake turbulence. Aircraft in flight leave behind large-scale swirling flows (vortices), which can represent a significant hazard to following aircraft, and therefore are of great importance for practical applications concerning air transport safety and capacity. The project focuses on unresolved fundamental aspects of wake dynamics, thus complementing the existing, mostly empirical knowledge obtained in previous projects.

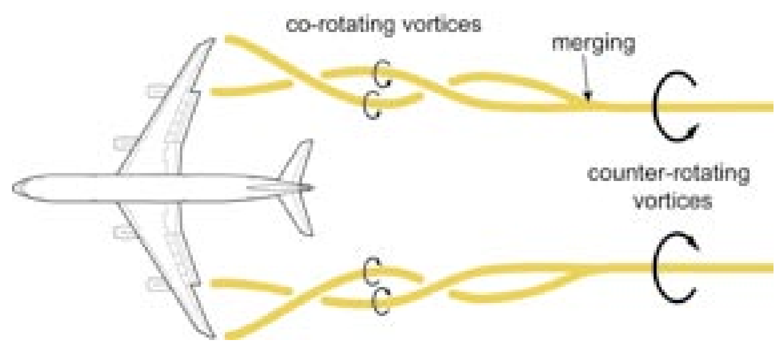
Project objectives

The main objective is to gain new knowledge about open issues of vortex dynamics relevant to aircraft wakes, and to provide a more systematic description than previously achieved of the phenomena involved in aircraft wake dynamics. These fundamental developments are necessary to achieve major advances in this domain, in view of a successful application of existing or future strategies for wake characterisation, prediction and alleviation. The topics include the precise role of vortex instabilities on wake decay, the influence of engine jets and fuselage wakes, and ground effects in wake evolution, relevant to the airport environment.

Description of the work

The FAR-Wake project contains four major Work Packages. In the first, studies related to the dynamics and instabilities of one or several vortices are considered. The second Work Package introduces additional features: jets from engine exhaust, and wakes (axial velocity deficits) generated by the fuselage or other wing elements. The third Work Package considers wake evolution near the ground, with special emphasis on the prediction of wake behaviour in this situation. The fourth Work Package deals with synthesis and assessment.

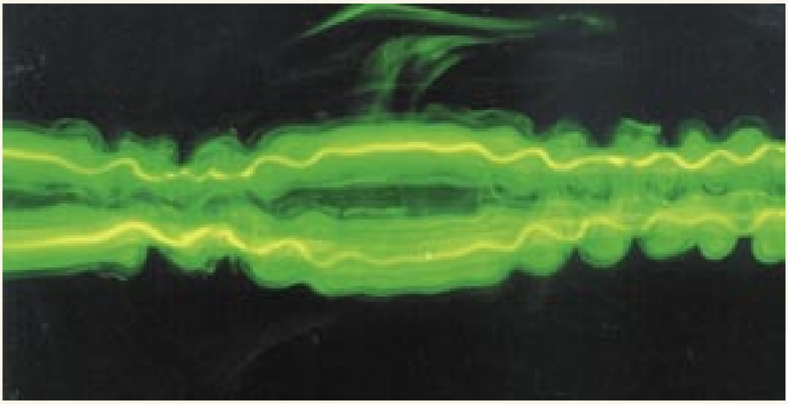
In the majority of cases, emphasis is put on the study of simplified geometries and generic vortex configurations, which facilitates the use of different complementary approaches. In support of new experimental and numerical investigations, theoretical/analytical treatment is applied, with the aim of obtaining a systematic description and comprehension



Vortices in the wake of a civil transport aircraft of the phenomena. Furthermore, extensive use is made of results and data from previous projects or available databases. The confrontation and comparison of different sets of results will validate the findings and make the description of the studied phenomena more complete. At the end, an important effort will be made to provide a synthesis of all the new fundamental results obtained, and to assess their relevance for the wake turbulence problem for real aircraft. Certain features found to be promising for the acceleration of wake decay, such as flows with multiple wake vortices, will be analysed and tested in a realistic configuration, using numerical simulations and experiments in a large-scale towing tank facility.

Expected results

This project will generate systematic results and physical understanding concerning previously unresolved issues related to aircraft trailing wakes, including the role of vortex instabilities, the influence of engine jets and fuselage wakes, and ground effects. This will create a solid knowledge base for future applications aiming at the reduction of wake turbulence hazards. Concerning ground effects, the project will in addition produce improved tools for the real-time prediction of wake vortex behaviour, to be used in the domain of Air Traffic Management.



Long- and short-wave instabilities in a vortex pair

Acronym:	FAR-Wake
Contract No.:	AST4-CT-2005-012238
Instrument:	Specific Targeted Research Project
Total Cost:	€3 060 024
EU Contribution:	€1 980 456
Starting Date:	01/02/2005
Duration:	36 months
Website:	www.FAR-Wake.org
Coordinator:	Centre National de la Recherche Scientifique (CNRS) 3, rue Michel-Ange FR-75794 Paris Cedex 16

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Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (CERFACS)	FR
Częstochowa University of Technology	PL
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
Instituto Superior Técnico (IST)	PT
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Technische Universiteit Delft	NL
Technische Universiteit Eindhoven	NL
Technische Universität München	DE
University of Bath	UK
Université Catholique de Louvain	BE
Universidad de Málaga	ES
Universidad Politécnica de Madrid	ES
Université Paul Sabatier – Toulouse III	FR

FIDELIO

Fibre Laser Development for Next Generation LIDAR Onboard Detection System

Background

The necessity of finding a practical solution for onboard detection of atmospheric hazards such as wake vortices, wind shear, and clear air turbulence is a well-established need, and has been the subject of intense European research in programmes such as MFLAME and now I-Wake. LIDAR has been shown to be an optimal tool for on-board detection of hazards. LIDAR systems used so far have been based on solid-state laser technology, which does not meet commercial aircraft requirements for onboard implementation due to power consumption, size, weight, reliability and high life cycle cost.

Project objectives

The purpose of this programme is to introduce the next logical step in wake vortex detection by developing a unique fibre laser technology (1.5 micron wavelength) geared for the aerospace industry requirements, enabling on-board realisation of a LIDAR atmospheric hazard detection system. The goals of this programme meet the Sixth Framework Programme strategic objectives including 'Improving Aircraft Safety and Security' and 'Increasing the Operation Capacity of the Air Transport System'. The numerous aerospace applications require both a high-level coherence and high energy per pulse, an issue which has not been addressed in the telecommunications and industrial laser technologies, hence the essential need to bridge this technological gap in fibre laser systems for aerospace applications. The fibre laser-based LiDAR to be developed in this programme will enable a major technological breakthrough attainable only at a European level with participation of the major European laser and aeronautics companies. The synergy with other EU programmes will enable the technological breakthrough essential in realising a feasible on-board aircraft safety system.

Description of the work

The development of the fibre laser-based Lidar system is a challenging task. Hence, the programme has been structured in a manner that enables risk reduction in order to reach the desired goals. The Work Packages are broken down into the following topics: programme coordination and management (lead by ELOP), System Specification and LiDAR Modelling (lead by ONERA), Laser Architecture and Modelling (lead by Thales Research & Technology), Fibre Development and Fabrication (lead by IPHT), Laser System Integration (lead by ELOP), LiDAR System Realisation (lead by ONERA), and Exploitation (lead by Thales Avionics). The system specification will be based upon previous EC programmes and will be geared specifically to the onboard requirements (size, power consumption, etc.). The fibre laser development is very challenging and includes high-energy requirements, single mode operation, single frequency, polarisation maintaining, and more. In order to reduce the risks in the programme, the initial stages of laser development will focus on three possible fibre laser architectures, each with their own advantages and disadvantages. After 18 months, the leading laser architecture will be decided upon and that architecture will be implemented in the final laser-engineering prototype. The fibres themselves are a critical building block in the system and hence much effort will be placed in the development of fibres able to meet all of the demanding requirements (single mode, high energy, polarisation maintenance, etc.). The engineering fibre laser prototype will be implemented in the LiDAR system where particular attention will be placed to the (real-time) signal processing and system testing. The testing will include ground testing at the end of a runway to measure the wake vortices. Although, due to budgetary limitations, the testing will be performed on the ground, the system will be developed so that the move to on-board implementation will be as smooth as possible. Exploitation will be a constant theme in the course of the programme, where a Users Club has been established (members include Dassault) to provide input to the relevant market and end-user needs. The I-Wake programme, which is in its final phases, will also be a source of input to the needs and requirements of the on-board system and so a synergistic use of the EC-funded projects will be seen.

Expected Results

The expectations of the project include realisation of a LiDAR system capable of accurately measuring the wake vortices and geared for on-board implementation. The fibre laser technologies will enable the leap forward to on-board implementation. The system will be designed so that solutions to the various on-board restraints, including power consumption, footprint, heat dissipation, environmental robustness, flexibility, etc. will be taken into consideration. The signal processing developed during FIDELIO will enable the move to real-time processing, demonstrating further convergence towards an on-board system.

Acronym:	FIDELIO
Contract No.:	AST4-CT-2004-012008
Total Cost:	€4 723 001
EU Contribution:	€2 795 849
Starting date:	01/12/04
Duration:	36 months
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Office National d'Etudes et de Recherches Aerospatiales	FR
Institute of Physical High Technology	DE
Thales Research and Technology	FR
CeramOptec GmbH	DE
Université catholique de Louvain	BE
Instituto de Engenharia de Sistemas e Computagdores do Porto	PT

FLYSAFE

Airborne Integrated Systems for Safety Improvement, Flight Hazard Protection and All Weather Operations

Background

Air traffic worldwide is expected to triple within the next 20 years. With the existing on-board and ground-based systems, this would lead to an increase of aircraft accidents, in a similar or higher proportion. Despite the fact that accidents are rare, this increase is perceived as unacceptable by society, and new systems and solutions must be found to maintain the number of accidents at its current low level. The first thing to be done is to provide the pilots with new systems allowing them to make the right decision at all times.

Project Objectives

FLYSAFE will be the first big step towards achieving Vision 2020 objectives for safety in airspace. It will allow the design, development, implementation, testing and validation of a complete Next Generation Integrated Surveillance System (NG ISS).

FLYSAFE will focus particularly on the areas identified as the main causes of accidents around the world: loss of control, controlled flight into terrain, and approach and landing. It will address the three types of threats: traffic collision, ground collision, and adverse weather conditions, and develop for each of them new systems and functions, notably: improved situation awareness, advance warning, alert prioritisation and enhanced human-machine interface.

FLYSAFE will also develop solutions to enable all aircraft to retrieve, in the near future, timely, dedicated and improved weather information by means of a set of Weather Information Management Systems (WIMS), which is able to gather, format and send to the aircraft all atmospheric data relevant for the safety of their flight, presented in an innovative and consistent way to the pilot. Innovative prediction capabilities will be deployed to provide warnings, which are optimised with respect to the simultaneous constraints of safety and airspace capacity.

Description of the work

The project starts with a review of the results of past and on-going investigation of accidents and incidents, the identification of all contributing causes, and the definition of ways to address them. The results of this analysis will then feed the evaluation tasks with scenarios that will be used to assess new versus state-of-the-art technologies.

The three main types of hazard sources for aviation have led to the creation of three project branches, with a fourth branch dedicated to the development of the Next Generation Integrated Surveillance System itself with the integration of their outputs.

- Atmospheric hazards' will develop means to increase the on-board awareness regarding all major sources of atmospheric hazards (wake vortices, wind shear, clear air turbulence, icing, and thunderstorms)
- 'Traffic hazards' will develop means to increase the crews' traffic situation awareness and provide them with information on potential traffic hazards along the flight path

– Terrain information management' will develop means to increase the crews' terrain and obstacle situation awareness, and provide them with information on the potential terrain and obstacle hazards along the flight path.

As part of the NGISS, innovative system functions will be developed, notably:

– Tactical alert management to help the crew to manage a tactical situation where an immediate response is required from them
– Intelligent Crew Support to help the crew with cockpit interface usage and standard procedures application in order to lower the occurrence of 'loss of control' situations
– Strategic data consolidation to anticipate any identified risks related to atmospheric phenomena, traffic and terrain, along the flight path in all flight phases
– New displays and audio management functions.

Standardisation and certification activities will pave the way for the introduction and promotion of future products, thus reducing the time to market.

Finally, the validation of the complete system and proof of concept, with both ground and on-board components, will be provided by a set of simulator and flight tests, involving a representative group of pilots.

Expected results

The project will culminate with the production of a complete safety-related integrated system (NG ISS), embodying all the innovations, connected to a test bed that will allow activation, running simulations and evaluation of the safety gains obtainable by future marketable systems based on those features.

The Weather Information Management Systems (WIMS) will be key deliverables of the project. They will have been validated in the project in support of the NG ISS, and will be used to enhance both the safety and efficiency of air transport through their use for provision of services to other stakeholders in the air transport sector (ATC, airlines).

Flight test results will be used to validate the complete chain of weather information processing (aircraft atmospheric data, downlink, WIMS and routine data, uplink, weather data fusion) and to populate a weather database to be used during the full simulation evaluation.

All these results will contribute to achieving the ACARE goal of reducing the rate of accidents by 80% within 20 years.

Acronym:	FLYSAFE
Contract No.:	AIP4-CT-2005-516167
Instrument:	Integrated Project
Total Cost:	€52 148 213
EU Contribution:	€29 006 999
Starting date:	01/02/05
Duration:	48 months
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	Diehl Avionik Systeme GmbH	DE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Met Office	UK
	Universität Hannover	DE
	Airbus Deutschland GmbH	DE
	Adria Airways, Airline of Slovenia, d.d.	SL
	Air Malta plc	MT
	AustroControl	AU
	Avitronics Research	EL
	AVTECH Sweden AB	SE
	Centre National de la Recherche Scientifique (CNRS)	FR
	Deep Blue	IT
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Eurocopter Deutschland GmbH	DE
	Euro Telematik A.G.	DE

Galileo Avionica S.p.A.	IT
GTD, Sistemas de Información, S.A.U.	ES
Hellenic Aerospace Industry S.A.	EL
Hovemere Ltd.	UK
Jeppesen GmbH	DE
Météo-France	FR
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Rockwell-Collins France	FR
Skysoft Portugal – Software e Tecnologias de Informaçao S.A.	PT
THALES Air Defence S.A.	FR
THALES Laser	FR
Central Aerohydrodynamic Institute (TsAGI)	RU
Université Catholique de Louvain	BE
Technische Universität Darmstadt	DE
Cranfield University	UK
University of Malta	MT
USE2ACES B.V.	NL
Dassault Aviation S.A.	FR

ISAAC

Improvement of Safety Activities on Aeronautical Complex Systems

Background

Avionic systems are becoming increasingly complex (heterogeneous components, large number of functions, and interaction with operators through advanced interfaces). Therefore, it is becoming harder to manage all aspects of safety assessment and to maintain the required safety levels. A Fifth Framework Programme project called ESACS (Enhanced Safety Assessment for Complex Systems) has shown the benefit of using formal techniques to assess aircraft safety. ISAAC builds upon and extends the ESACS results to go a step further towards the improvement and integration of safety activities of aeronautical complex systems.

Project objectives

The ISAAC project aims to increase the capability and efficiency of safety and systems engineers to perform safety assessments resulting in secure systems. The proposed methodology, built on formal method techniques, is an integrated part of a model-based development process where safety and reliability aspects are examined in the early steps of development.

The goals of the project are:

- to consolidate the ESACS results by improving analysis for dynamic aspects like sequencing or temporal behaviour
- to extend the scope of the integrated environment among designers and safety/reliability engineers
- to take into account results from tools used in performing particular risk and zonal safety analysis and to use this information to analyse unintended interactions injected into independent 'intended functionality' but co-located systems
- to evaluate the relationship between man and machine offering a complex human-complex machine interaction model
- to automate the analyses to determine the impact of degraded situations on system operating modes and over predefined missions
- to exploit the use of ESACS formal verification techniques to deal with testability aspects.

Description of the work

To reach the above goals, the ISAAC work will follow detailed technical and scientific objectives organised into three complementary dimensions, which are structured into basic topics.

First dimension: Consolidation of ESACS work

Integration with higher-level notations for requirements, extension of traditional techniques to timing aspects and quantitative analysis, further development of platform/tools already started in ESACS.

Second dimension: Extension to other safety related aspects

Human errors, common cause analysis, mission analysis and testability.

Third dimension: Commonalities

Common methodology recommendations and common tools and libraries that facilitate exchanges among tools will be identified in order to provide a more comprehensive tool-supported coverage of the safety process.

Expected results

A comprehensive methodology of different safety-related aspects, supported by tools that allow the various analyses. The main benefit is that activities of designing and doing analysis can be performed more easily in an iterative manner resulting in a more effective development process, where the results of the analysis can influence the design in a short period of time. Moreover, the traceability of safety issues and of relevant design changes will be improved, enhancing the visibility in the perspective of the certification process.

Acronym:	ISAAC
Contract Nr.:	AST3-CT-2003-501848
Total Cost:	€9 496 751
EU Contribution:	€5 361 941
Starting Date:	01/02/2004
Duration:	36 months
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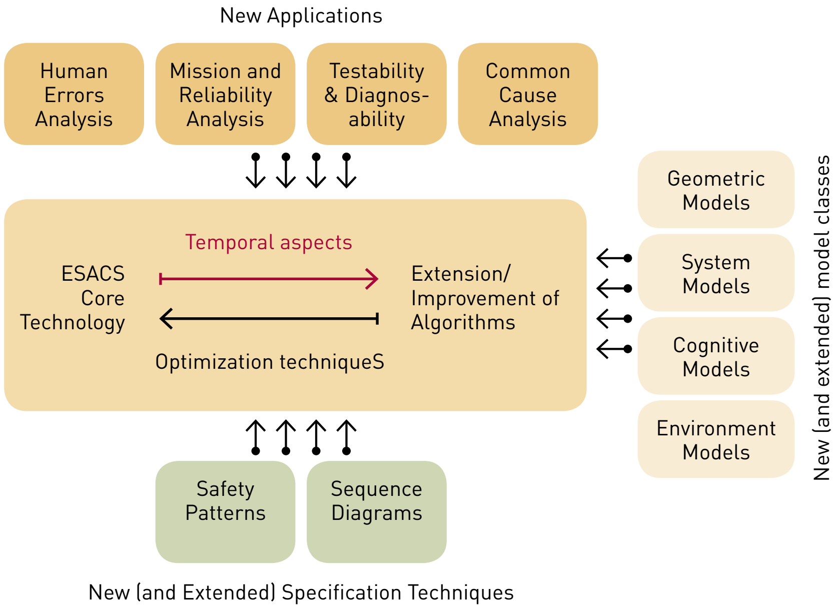
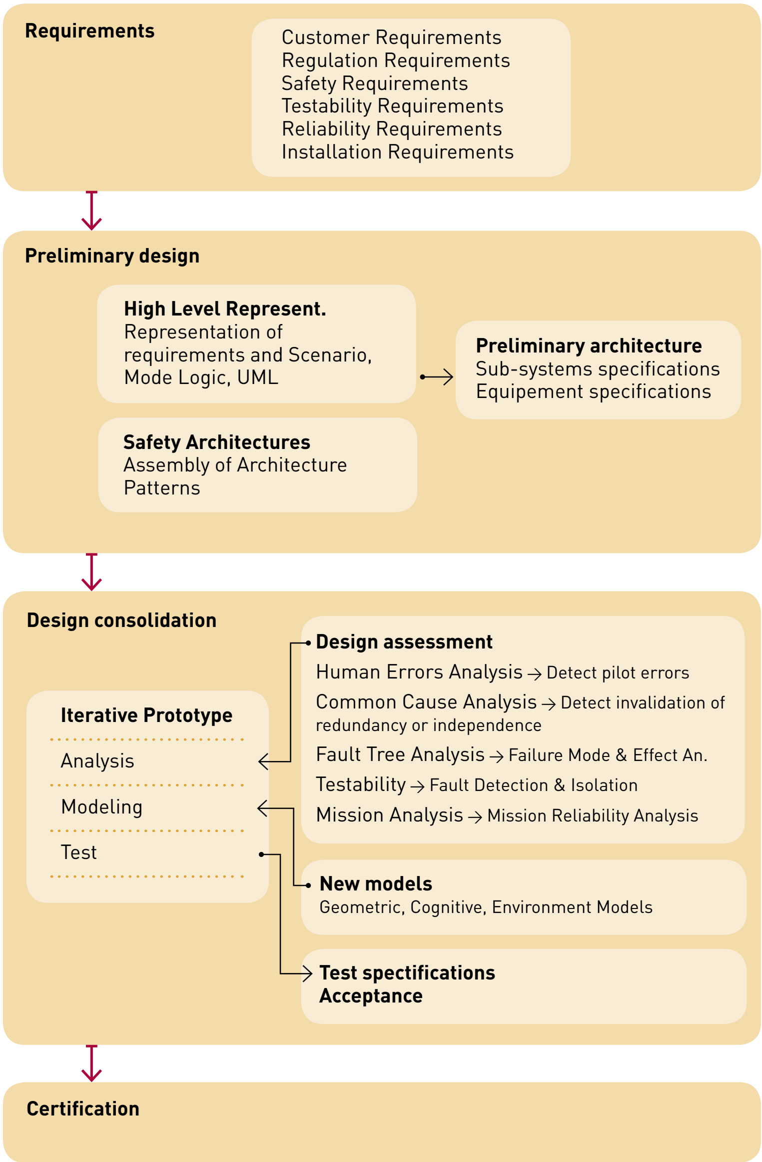
Partners:	Alenia Aeronautica S.p.A.	IT
	Airbus France S.A.S.	FR
	Airbus UK Ltd.	UK
	Airbus Deutschland GmbH	DE
	Saab AB	SE
	Societa' Italiana Avionica S.p.A.	IT
	Instituto Trentino di Cultura	IT
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Kuratorium OFFIS e.V.	DE
	Prover Technology AB	SE
	Dassault Aviation S.A.	FR

ISAAC Areas of Investigation



ISAAC Technical application scenario



Lightning Protection for Structures and Systems on Light Aircraft Using Lightweight Composites

Background

Lightweight composite materials, especially carbon fibre, are being increasingly used in light and large aircraft construction, but composite airframes also give less intrinsic electromagnetic shielding to structures and systems compared to aluminium, particularly for light aircraft. This proposal addresses the need to investigate and optimise lightning protection systems for aircraft with lightweight composite structures.

Project objectives

The programme will consider where lightning protection has been found difficult to incorporate in the design or certify, because of the lack of available test data, and will provide proven design approaches. Impulse loads will be measured, their effects modelled, and validated against test sample results. Avionics protection/power wiring systems protection will be investigated, along with canopy protection. The ultimate aim will be to provide general guidelines for certification. Both high current and high voltage-testing facilities will be applied, in order to:

- Identify lightning protection solutions for lightweight composite structures, flight control surfaces, fuel systems and avionics systems, and provide design guidelines.
- Carry out lightning strike testing and modelling of materials, structures and components to provide data to support the early design phase and type certification. Materials to be investigated will include lightweight composite skins with carbon, glass, foam or honeycomb.
- Investigate the use of fibre optic strain gauging to monitor the structural health of airframes after lightning strike.
- Investigate avionics systems and power bus protection, including testing of mock-up systems.

Description of work

Review and Plan: Review of protection materials available, including woven mesh, expanded foil, and woven Al/carbon fabric, and some possible novel materials.

Flat Panel Testing: Lightning arc attachment tests will be carried out on 160 flat panel samples, in a matrix of different protection and manufacturing methods. The lightning arc attachment tests will be carried out at different test levels. Damage effects and impulsive loads at the panel surface will be recorded.

Larger Structure: Tests will be carried out on components such as elevators, rudders and wing structures, manufactured using a selection of the optimised techniques identified in the flat panel tests. These tests will check that the flat panel tests give the same typical results as the larger structure tests, so that they can in future be used with confidence as a certification method.

Fuel Tank Skins: This will include the protection of the structure against sparking. Typical installations of components such as fuel filler caps will also be checked, in order to identify and test generic design approaches, which have inherent protection against sparking.

Structural Strength Monitoring: The main spar of the test wing to be provided by AEL will be instrumented with built-in fibre optic strain gauges. Prior to the lightning strike test, the 'healthy' state can be recorded by simple loading at the wing tip and, after the lightning strike, can be checked for changes in strain exhibited under the same loading.

Structural Modelling: carried out in conjunction with the flat panel tests:

- to understand the impulsive nature of the forces during lightning attachments, which will allow modelling to predict the lightning levels at which different structures will fail
- to develop an equivalent simple mechanical impulse test that can simulate the impulsive loads from lightning attachments.

Insulating Structure Protection: New testing standards for lightning include tests to determine whether a swept lightning arc can puncture aircraft canopies. High voltage tests to a standard acrylic canopy will be carried out to provide supporting test data to certificate all similar designs of canopy installations on general aviation aircraft.

Power Systems Protection: To investigate installation and protection techniques (appropriate cable routing, bonding and grounding), investigated on a power bus mock-up, including forward fuselage, firewall and engine support truss.

Avionics Systems Signal Wiring: The test bed would include cable bundles, avionic racks, instrument panel, and various screening and shielding methods. The objective is to define an optimised avionics installation in which the transient levels can be kept below those defined as level 3 in RTCA DO-160D.

Expected Results

The main deliverable of the programme will be validated lightning protection design guidelines for small aircraft, as well as experimental data to help support aircraft certification for lightning. The scope of the work will include lightning protection for conducting or glass composite structures, fuel systems, avionics and electrical power systems. The project will aim to reduce the weight penalty of lightning protection by 50%. In order to achieve these general objectives, lightning protection of different critical functions of the aircraft will be devised and demonstrated.

Acronym:	LIGHTNING
Contract nr.:	AST4-CT-2005-012270
Total Cost:	€1 567 150
EU Contribution:	€882 715
Starting Date:	01/08/2005
Duration:	24 months

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Extra Flugzeugproduktions-und-Vertriebs-Gmbh	DE
Diamond Aircraft Industries GmbH	AT
Airbus España S.L.	ES
Hexcel Reinforcements	FR
Iscom Composites Institute	IL

ONBASS
Onboard Active Safety System

Background

Due to the growth of complexity and cost of aviation operations caused by the increase in the number of aircraft and air traffic, it has become clear that in the not too distant future it will be impossible to provide and maintain appropriate levels of flight safety with the current safety systems and aviation infrastructure. The aim of the ONBASS project, therefore, is to propose, analyse and develop the innovative Principle for Active System Safety (PASS) for aviation. Rather than just recording data during an aircraft's flight, in order to allow post-crash analysis to be carried-out, ONBASS proposes the analysis of available data in real time during the flight and reacting on them with the aim of accident prevention.

Project objectives

ONBASS is concerned with the formulation of the theoretical principles of aviation system safety: the flight safety (risk) model, the information flow model and the control system model. These models make it possible to determine the scope of the applicability of ONBASS. Subsequently, analysis of the dependencies within and between the models will permit the definition of the features, functions and structures of the system, software and hardware. A comparison between the existing and the proposed system structure of aviation safety will be drawn-up with the aim of optimising the project's outcomes. To match this demand, the scope of ONBASS is the following:

1. Further theoretical and conceptual development of the active safety principle and formation of theoretical models to analyse the limits of the principle's applicability.

2. Research and development of basic fault tolerant hardware elements for the on-board part of the active safety system.

3. Concepts, design and development of a resilient system software core for the active safety system.

In terms of the system software, the main characteristics of ONBASS will be extremely high reliability, fault-tolerant concurrency, recoverability of processed data, support mechanisms for real-time fault detection, system reconfiguration in case of hardware fault or degradation, high performance and hard real-time scheduling. In terms of system hardware, ONBASS will provide the highest possible reliability, recoverability, fault tolerance, thermal and vibration resistance, survivability and graceful mechanical degradation.

Description of work

The initial phase of the project covers the theory and operational model, taking into account the intended application domain of general aviation. After a systematic survey of the application domain and the processing of existing statistical data within it, the profile of flight risk for commercial and general aviation will be developed. With this data available, in combination with the analysis of existing systems, a conclusion will be made about features of operational models that will enable an operational risk analysis in flight real-time. From the operational risk analysis model, a reliability model of flight will be derived, aiming at the possibility of real-time prognosis of flight risk. The programming of the reliability model and a simulation of its operation in real-time data processing will be carried out.

Based on this, the overall system will be defined and specified. The objectives of this work are to clearly and concisely define the overall requirements of the system, both from the external point of view of its users and also in terms of its internal function, and to ensure that the safety context and safety requirements are clearly defined. The outcome of this work will be a system specification covering software, hardware and overall system aspects, which include safety, certification and qualification and human-machine interface issues.

After this step, the software and hardware modules of the demonstrator will be developed in parallel. This work will begin with a definition of the respective software and hardware structures, and will be completed with the verification of the software modules and the hardware prototype. The main objective of the hardware-related work consists of developing a highly reliable system including fault-tolerant processors, system memory, flight memory and communication interfaces.

Finally, the verified software modules will be integrated into the corresponding hardware prototype and an overall system verification will be performed, making use of suitable simulation and laboratory set-ups. Once the overall system performance has been verified, the ONBASS prototype will be installed on-board a general aviation aircraft in order to verify the system in flight. However, the flight hours will be limited. This means that validation activities onboard the aircraft are out of the scope of this project.

Expected Results

The expected results of the ONBASS project can be summarised as follows:

- Availability of an operational model and a theoretical model of flight risk.
- Rigorous system requirements for the realisation of the principle of active safety systems.
- Conceptual design and a prototype development of the relevant system software.
- Conceptual design and prototype development for on-board embedded hardware.
- Overall ONBASS prototype that will demonstrate the requested capabilities in-flight.

Acronym:	ONBASS
Contract No.:	AST4-CT-2004-516045
Instrument:	Specific Targeted Research Project
Total Cost:	€3 086 500
EU Contribution:	€1 941 000
Starting Date:	1/1/2005
Duration:	36 months
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	Eidgenössische Technische Hochschule Zürich	CH
	ORATION S.A.	EL

HeliSafe TA

Helicopter Occupant Safety Technology Application

Background

Flying fatalities are up to ten times more likely in helicopters than in fixed wing aircraft. Due to the nature of use of most civil helicopters (police, emergency service, fire fighting, power line inspection, etc.) accidents occur mainly in risky operations in low altitudes and when lifting off and landing. In both cases, occupants have a greater chance of surviving or avoiding severe injuries by use of improved safety equipment.

Project objectives

The main objective is to improve the probability of survival and reduce the risk of injuries to occupants in helicopter crashes. The research and development work focuses on improving occupant protection, based on the fact that the automotive industry is significantly more advanced in restraints compared to the aeronautical industry safety standards. Passenger safety standards for aircraft are lagging 15 to 20 years behind the automotive state-of-the-art technology. Therefore it is one of the aims of HeliSafe TA to integrate passive/active safety elements into helicopters and, furthermore, to utilise existing experience of the automotive industry to develop and introduce new passive/active safety equipment for occupants in helicopters. Such safety equipment must be able to protect occupants independent of their weight, size and seat position (side-facing seats, resting position, lying on stretcher, etc.).

Description of work

Specification:

The overall spectrum of real world helicopter accidents will be studied, in order to define a relevant and representative crash scenario to be carried out in a full-scale drop test. The effect of the helicopter interior and the different seat arrangements shall be investigated. Supplemental injury probabilities are to be determined to improve the possibilities for self-evacuation, especially in the risk of post-crash events. A realistic crash pulse and loads will be defined, comparable to real world scenarios to determine the improvements for proposed safety equipment.

Development/ Research:

Improved safety equipment hardware will be defined and produced to carry out all planned experimental static and dynamic tests. Standard dummies will be appropriately modified for helicopter crashes, for injury assessment and critical occupant size. All hardware configurations will be transferred to numerical models. A crash sensor/sensor network and an electronic control unit (ECU) applicable for dynamic crash tests will be specified.

Analysis/ Innovation:

The safety analysis and simulation tool concept (HOSS - Helicopter Occupant Simulation Software concept) shall be optimised to cover the interaction of all relevant safety equipment, in particular to extend the modelling capability to include the more complex cabin and cockpit systems, extended safety system concepts and more complex crash scenarios. Use of the analysis methods will be made to define an active/passive occupant safety concept for helicopters, by performing parameter studies and assessment regarding effectiveness of injury mitigation.

Testing:

Newly developed safety equipment, interfaces and mock-ups will be manufactured for a generic helicopter cockpit and cabin to perform all experimental static and dynamic tests. Data will be collected and feedback will be supplied for validation of the simulation tools technology.

Assessment:

Relevant data will be collected to evaluate the HeliSafe TA results concerning transferability to fixed wing aircraft. The authorities will be supported on their decision process for future rule making on how the proposed safety concept could be introduced in existing/future helicopters.

Expected results

Initial accident investigations show that in spite of using restraints, fatal or severe injuries caused by preventable head strikes and associated neck injuries mean that existing safety equipment in helicopters is not sufficient for occupant protection during a crash. It is expected that helicopter-related crash fatalities could be reduced by 30 to 50% if effective protective devices for occupants could be installed in helicopters. It is intended to transfer HeliSafe TA technology to fixed wing aircraft.

Acronym:	HeliSafe TA
Contract No.:	AST3-CT-2004-502727
Instrument:	Specific Targeted Research Project
Total Cost:	€4 753 599
EU-Contribution:	€2 700 000
Starting Date:	01/03/2004
Duration:	36 months
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Partners:

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Fundación para la Investigación y Desarollo en Automoción	ES
Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
Eurocopter S.A.S.	FR
Eurocopter Deutschland GmbH	DE
Politecnico di Milano	IT
Wytwornia Sprzetu Komunikacyjnego 'PZL-Swidnik' S.A.	PL
Siemens Restraint Systems GmbH	DE
Netherlands Organisation for Applied Scientific Research (TNO)	NL
Coventry University	UK
Technische Universiteit Delft	NL

AERONEWS

Health monitoring of aircraft by Nonlinear Elastic Wave Spectroscopy

Background

Recent advances in aeronautics require the development of non-destructive evaluation (NDE) techniques that allow the quantification of micro-structural damage in a wide variety of materials during their manufacture and life cycle, ensuring both their quality and durability. Traditional NDE techniques, such as high quality linear acoustic, electromagnetic and visual inspection methods are not sufficiently sensitive to the presence and development of domains of incipient and progressive damage. For this purpose, AERONEWS will focus on the development and validation of an innovative micro-damage inspection system based on Nonlinear Elastic Wave Spectroscopy (NEWS).

Project objectives

The primary objective of this project is to enhance and implement new experimental and simulation tools necessary to measure, characterise, predict, quantify and locate early-stage damage in aircraft components and structures, based on the nonlinear response of the materials. Nonlinear Elastic Wave Spectroscopy (NEWS) has proven to be very sensitive and effective in detecting micro-damage in materials at early stages of failure, and long before linear acoustic properties show signs of material degradation. The focus will of this project will be on the following:

- expansion of the present knowledge of the nonlinear behaviour of progressive fatigue damage in aircraft parts and structures
- development of explicit sensor systems and advanced self-monitoring components
- formulation of an integrated design for a testing procedure and a unique engineered monitoring system for micro-damage inspection, including remote control and communication tools
- validation of the applicability of the system to real time in-situ inspection of a full-scale model on the ground.

Description of work

The academic capabilities and usefulness of NEWS techniques will be extended in five ways, by:

- Validating and certifying the use of NEWS in aeronautics by extending the application of NEWS methods on materials and objects for which there is a pronounced need in aeronautics (Work Package 1), and by formulating recommendations for the selection between different NEWS techniques with respect to materials, structures and experimental situations.
- Proposing and developing the methodology for a NEWS technology-based imaging system (NEWIMAGE) through intensive NEWS modelling and enhanced numerical support for nonlinear acoustic imaging techniques of damage (localisation) (Work Package 2).
- Designing smart transducer/sensing systems by developing innovative transducer-receiver systems for embedded instrumentation and advanced NDE (Work Package 3), along with comprehensive data recording and analysis tools (Work Package 4).

– Preparing the necessary grounds for the development of a test device measurement system by combining the NEWS ideas with advanced transducer solutions (Work Package 3), wireless and remote communication capabilities and a user-friendly graphic interface (Work Package 4) to develop an efficient, semi-automatic and reliable package for the monitoring and identification of microdamage.
– Verification of the capabilities of the health monitoring system by integrating the measurement system as a portable or permanent damage diagnostic tool on selected key aircraft parts of a full-scale model on the ground (Work Package 5).

Expected Results

The development and preliminary verification of an innovative NEWS-based NDT technology and its engineering applications in aeronautics envisaged in this project will result in an enhanced, reliable and integrated prototype measurement system and protocol for micro-crack diagnostics of selected aircraft components and structures. Due to the increased sensitivity of the technology, it is expected that this development will result in a significant increase in aircraft and passenger safety while contributing to substantial cost savings through a decrease in maintenance and operating times. The long-term goals are the engineering of a standard measurement system based on NEWS for continuous health monitoring and early stage damage diagnosis.

Acronym:	AERONEWS	
Contract No.:	AST-CT-2003-502927	
Instrument:	Specific Targeted Research Project	
Total Cost:	€4 874 745	
EU Contribution:	€3 562 596	
Starting Date:	01/03/2004	
Duration:	48 months	
Website:	http://www.kulak.ac.be/AERONEWS/	
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Partners:	Katholieke Universiteit Leuven	BE
	Vrije Universiteit Brussel (VUB)	BE
	ASCO Industries N.V.	BE
	Zemedelske druzstvo Rpety se sidlem ve Rpetec	CZ
	Institute of Thermomechanics - Academy of Sciences of the Czech Republic	CZ

Vyzkumny a Zkusebni Letecky Ustav, A.S. (VZLU)	CZ
Groupement d'Intérêt Public 'Ultrasons'	FR
NDT Expert	FR
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	DE
Politecnico di Torino	IT
Università di Napoli 'Federico II'	IT
Consejo Superior De Investigaciones Científicas	ES
Boeing Research & Technology Centre	ES
CSM Materialteknik AB	SE
University of Exeter	UK
University of Bristol	UK
University of Nottingham	UK
Cranfield University	UK

AISHA

Aircraft Integrated Structural Health Assessment

Background

The structural health of engineering structures is increasingly threatened by material degradation. Reliable means of health monitoring are therefore required for safe operation. Based on this monitoring, maintenance actions can be undertaken. Whereas a time-based inspection scheme has resulted in excellent reliability records for aircraft, there is an economic drive for more innovative health monitoring procedures. Recently, it has been proposed to switch from time-based towards condition-based procedures, where maintenance is only performed when a component is known to be degraded. This requires a means of continuously assessing the structural integrity of the aircraft by a continuous damage monitoring system.

Project objectives

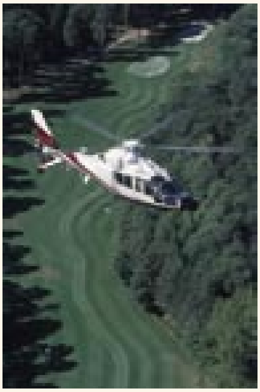
This project aims to develop aircraft monitoring technology by exploring ultrasonic waves as the basic sensing principle. Both active and passive wave inspection will be explored, using the innovative concept of multimode wave generation and reception. The information from these waves, combined with signal analysis routines and models for remaining lifetime prediction, will ultimately be used in a full-scale testing action during which the possibilities for large-scale application will be explored. A consortium with broad and multidisciplinary expertise has been formed, with contributions from high tech SMEs, university research groups, end-users and a certification laboratory.

Description of the work

It is suggested to use a limited number of Lamb wave modes in the detection process. As a first step in the project, optimum Lamb wave mode sets will be selected, taking into account the material under investigation, loading condition and damage type. Novel sensors/actuators will be developed for selectively generating and detecting Lamb wave modes. Methodologies for the integration of sensors and actuators into the structure will be explored. A major part of the project will be devoted to establishing quantitative relations between growing damage phenomena and detected signals. This step will be aided by the development of automated signal analysis strategies, which aim to provide either a visualisation of the data or a multidimensional analysis. A separate action will be devoted to providing the link between the monitored results and the actual structural condition. Based on a sound knowledge of the amount of damage present, a conclusion will have to be drawn about the fitness for service of the structure and the need for repair. This will require an adequate modelling of damage states, calculating residual properties and predicting the remaining lifetime. A final research action will be devoted to a full-scale testing of the obtained laboratory results.

Expected results

On the way towards the main project goals described above, a number of results are being generated through co-operation in the consortium. A digital and searchable database has been constructed, containing common structural aircraft materials together with their relevant properties and degradation mechanisms. An important result of the project will be the understanding of the interaction of propagating Lamb waves with material defects in metals and long fibre composite materials. The use of this knowledge is not confined to the study of aircraft materials, but can also be used for the inspection of other structural parts that exhibit defect formation, such as chemical process installations with corrosion cracks or structural composites that are subject to impact or fatigue damage evolution. Towards the end of the project, a way of monitoring will be tested at full scale, giving additional information on the issues encountered while scaling up lab techniques. In addition, the concepts predicting the remaining lifetime of structures during damage generation and evolution can be used for other applications.



Wing with extended slat tracks during MRO. The transition from time-based to condition-based maintenance, based on Lamb wave ultrasonic inspection, will be the focus of AISHA.

Acronym:	AISHA	
Contract No.:	AST3-CT-2003-502907	
Instrument:	Specific Targeted Research Project	
Total cost:	€3 367 564	
EU contribution:	€2 027 713	
Starting date:	01/01/2004	
Duration:	36 months	
Website:	www.aishaproject.info	
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	Cedrat Technologies S.A.	FR
	Eurocopter S.A.S.	FR
	Riga Technical University	LT
	Fundación Centro de Tecnologías Aeronáuticas	ES
	TEGRAF Ingeniería S.L.	ES
	ASCO Industries N.V.	BE

ARTIMA

Aircraft Reliability Through Intelligent Materials Application

Background

An acute need exists to be able to develop the capability of reliably monitoring aircraft structural health in real-time. Real-time structural health monitoring will improve the overall safety and make it possible to replace corrective or preventive maintenance modes with much more efficient predictive or proactive maintenance procedures, thus reducing the associated costs. Similarly, vibrations and noise levels are still too high in certain aircraft. Systems based on smart materials, defined as solid-state actuators activated by external fields, can address all these factors.

Project objectives

The objective of the ARTIMA project is to achieve a significant improvement in aircraft reliability through the application of smart materials. These materials are considered ideal, both for reducing the probability of failure through vibration control and for detecting in time the defects that have already occurred.

The proposed project will provide the momentum to produce realistic industrial solutions for real-time structural health monitoring and aircraft vibration reduction. The most promising methods will be tested on large-scale specimens, including a portion of a commuter aircraft fuselage. A network consisting of several production companies, research institutes and universities will achieve the project's goals. The expertise developed as part of this project will be ideal to stimulate the creation and development of small, high-tech enterprises.

Description of the work

ARTIMA's objectives will be achieved through the collaborative effort of eleven organisations from seven countries. Smart materials, such as piezoplates, and Magnetic Shape Memory Materials will drive the active systems in structural health monitoring and vibration damping applications that are to be developed. Optical (FBG) sensor systems will be applied for passive load monitoring and damage detection. These systems will be tested in a realistic environment on a portion of the rear fuselage of a commuter aircraft and in another airframe part, most likely an elevon.

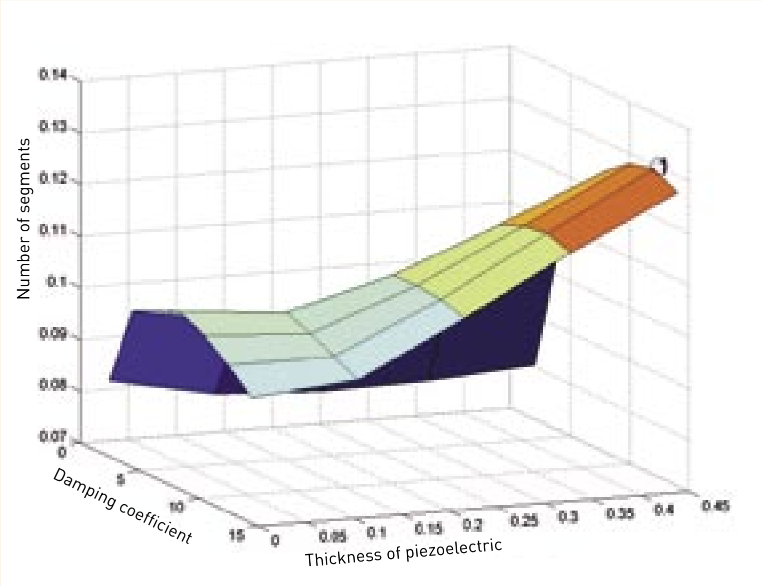
The extra benefit of this project, which will contribute to both damage detection and vibration control, will be the development of a new icing detection system. Icing may be considered as 'reversible damage'. It does do damage, but it mainly affects the less tangible factors, such as aerodynamic qualities. The resulting deterioration may create excessive vibration levels and lead to a total hull loss.

The project will begin by specifying the parameters of specimens to be tested. This work will be organised as Work Package 1. Work Package 2 will cover the analytical studies intended to better define the characteristics of systems to be tested, and to develop the necessary models and algorithms. The work done in this Work Package will help in making important decisions regarding the analytical tools used in the following portions of the project. Work Package 3 is where the small-scale specimens will be designed and fabricated. These specimens will be used to evaluate practical issues associated with implementing the selected systems, and to validate the models and algorithms developed in the course of Work Package 2. Large-scale specimens will be designed and fabricated, as part of Work Package 4. The lessons learned in the course of Work Package 3 will be extensively applied in the process of the large specimen fabrication. All the specimens fabricated previously will be tested as part of Work Package 5. Results of these experiments will be analysed as part of Work Package 6. These results and the experience acquired during the project will be a basis for making design recommendations, a part of Work Package 7. A smooth flow of work will be assured and the inevitable problems will be solved as part of Work Package 8.

Expected Results

The project will:

1. develop a real-time structural health monitoring system for real aircraft parts with acceptable reliability (low rate of false alarms and missed defects)
2. develop a practical, robust Active Constrained Layer Damping treatment for aircraft
3. develop a rotor blade icing detector capable of measuring ice thickness on the rotor blade, and the ice distribution and accumulation rate. PZT-based systems will be tested
4. investigate the feasibility of applying encapsulated PZT actuators and Magnetic Shape Memory Actuators for wing vibration control.



Damping treatment performance as a function of active constraining layer segmentation and constraining layer thickness. The focus of ARTIMA is dealing with vibration damping and health monitoring through smart, active materials.

Acronym:	ARTIMA	
Contract No.:	AST3-CT-2004-502725	
Instrument:	Specific Targeted Research Project	
Total Cost:	€4 940 552	
EU Contribution:	€2 839 322	
Starting Date:	01/12/2004	
Duration:	36 months	
Website:	http://www.aero.upm.es/artima	
Coordinator:	Gamesa Desarrollos Aeronáuticos, S.A. (GDA) Avda. Llano Castellano, 13 - 6a planta ES-28034 Madrid	
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EC Officer:	Hans Josef von den Driesch Tel: +32 2 296 0609 Fax: +32 2 299 2110 E-mail: hans-josef.von-den-driesch@cec.eu.int	
Partners:	Gamesa Desarrollos Aeronáuticos S.A.	ES
	Adaptamat Ltd.	FI
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	EADS Deutschland GmbH	DE
	Eurocopter Deutschland GmbH	DE
	Swedish Defence Research Agency (FOI)	SE
	Institute of Fluid Flow Machinery (IFFM)	PL
	Instituto Superior Técnico (IST)	PT
	Tecnatom S.A.	ES
	Universidad Politécnica de Madrid	ES
	University of Sheffield	UK

HILAS

Human Integration into the Lifecycle of Aviation Systems

Background

In a complex system like aviation, the human operator (pilot, air traffic controller, maintenance technician) plays a critical role, both within and between subsystems. Optimising this role requires new design to reflect real human operational requirements. The HILAS project will develop a 'system life-cycle' model in which knowledge generated about the human aspects of the system at the operational end is transformed into an active resource for the design of more effective operational systems and better, more innovative, use of technologies.

Objectives

The HILAS project contains four parallel strands of work: the integration and management of human factor knowledge; flight operation processes and performance; the evaluation of new flight deck technologies, and the monitoring and assessment of maintenance operations. A knowledge management system linking all the strands of the project will facilitate the use of the project's knowledge, both inside and outside the project. It will also examine how to transform operational knowledge to stimulate new design concepts. A standardised European model for flight operation performance monitoring and process improvement will be developed using cockpit integration technology. The evaluation of new flight deck technologies will address new and emerging technologies, such as synthetic vision, head-mounted displays and multi-modal dialogue systems. The human factors of these technologies will be evaluated in an integrated simulation rig. An integrated and standardised set of tools and methods will be developed for assessing and managing human factors across the aircraft maintenance lifecycle, from design to operations.

Description of the work

The Knowledge Integration strand develops the knowledge base of usable human factors knowledge. It will develop a knowledge management system; it will facilitate the use of that knowledge through the management of user groups and user activities; it will establish the requirements for the implementation of that knowledge and will examine how that knowledge should be transformed to stimulate new design ideas. Finally, it will evaluate how well the project manages its knowledge in order to create innovation possibilities.

The Flight Operation strand will develop a standardised methodology for System Design and Performance Management through three main phases. Phase 1 develops and integrates the relevant methods of process design and performance monitoring within a common software environment. Phase 2 provides a full-scale trial of this system through the full cycle from initial process analysis and performance monitoring to redesign, implementation and final performance monitoring. Phase 3 will then validate and standardise this model with further trials with airlines in different European regions.

The Flight Deck Technology strand will select a range of new and emerging technologies, which can support or contribute to relevant new flight deck application requirements. These technologies will be integrated into an existing simulated flight deck environment, which will enable a comprehensive human factors evaluation. This evaluation will proceed in two stages. After the first evaluation,

HILAS aims to optimise the human factor element of the air transport system

legende

both the evaluation tools and the hosting of the application on the technologies will be refined. The outcome of the second evaluation will be a new cockpit display and control technologies that have been specified and evaluated.

The Maintenance strand will develop and standardise a prototype maintenance management system. The first phase will review and evaluate existing tools and will define requirements for an integrated system (including requirements for new tools). The second phase will develop this prototype-integrated system, including some implementation trials. The third phase will evaluate the integrated system through full-scale trials and will validate the component methodologies. The fourth phase will standardise these methodologies across European organisations and assess their global applicability.

Expected achievements

The primary focus of the project is on reducing the potential impact of human error on the safety of aviation systems. This will be achieved through the delivery of appropriate human factor knowledge throughout the system to improve design, operation or monitoring. The project will contribute to human factor standards development by regulatory bodies. It will link performance assessment in flight operations and aircraft maintenance to system and process improvement, and will demonstrate how new technologies can be used in flight deck tasks to reduce the incidence of human error.

Acronym:	HILAS	
Contract No:	AIP4-CT-2005-516181	
Instrument:	Integrated Project	
Total Cost:	€28 000 404	
EU Contribution:	€16 997 779	
Starting Date:	01/06/2005	
Duration:	48 months	
Website:	www.hilas.info	
Coordinator:	The Provost Fellows and Scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth near Dublin, (TCD), College Green IE-Dublin 2	
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HILAS Partners	Trinity College Dublin	IE
	Smiths Aerospace	UK
	Joint Research Centre (JRC)	INT
	Aircraft Management Technologies Ltd. (AMT)	IE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Adria Airways, The Airline of Slovenia, d.d.	SL
	THALES Avionics S.A.	FR

SAS Braathens AS	NO
Messier-Dowty Ltd.	UK
SR Technics Ireland Ltd.	IE
Frederick Institute of Technology	CY
Technische Universiteit Delft	NL
Lunds Universitet	SE
Kungliga Tekniska Högskolan (KTH)	SE
Avitronics Research	EL
Fraunhofer-Institut für Fabrikbetrieb und -automatisierung IFF	DE
DEDALE S.A.	FR
Selenia Communications S.p.A.	IT
Rockwell Collins (UK) Ltd.	UK
Eurofly S.p.A.	IT
QinetiQ Ltd.	UK
Lufthansa Systems FlightNav Inc.	CH
Netherlands Organisation for Applied Scientific Research (TNO)	NL
Shevlin Technologies Ltd.	IE
Galileo Avionica S.p.A.	IT
Deep Blue	IT
KITE Solutions s.n.c.	IT
Elbit Systems Ltd.	IE
BAE Systems (Operations) Ltd.	UK
AVTECH Sweden AB	SE
Universidad de La Laguna	ES
EasyJet Airline Company Ltd.	UK
Futura International Airways S.A.	ES
ATITECH S.p.A.	IT
Noldus Information Technology B.V.	NL
Iberia Líneas Aéreas de España S.A.	ES
Rijksuniversiteit Groningen (RuG)	NL
Civil Aviation University of China (CAUC)	CHI
Turbomeca S.A.	FR
Centre for Research and Technology - Hellas	EL
Institute of Communication and Computer Systems	EL

SMIST
Structural Monitoring with Advanced Integrated Sensor Technologies

Background

The continued growth in air traffic has placed an increasing demand on the aerospace industry to manufacture aircraft at lower costs, while, at the same time, ensuring the products are efficient to operate, envi-ronmentally friendly and maintain the required level of safety. The primary objective of the aero-space industry is to offer products that not only meet the operational criteria, in terms of pay-loads and range, but also in terms of significantly reduced direct operating cost, which is to the benefit of their customers, the airlines.

Project objectives

The objective of the proposed project is to allow the best and most advanced sensing technologies to become an integral part of the aircraft structure and so thus implement Structural Health Monitoring (SHM) into aircraft structural design with respect to maintenance cost reduction, increased aircraft availability and significant weight savings.

The main project target is to develop and validate monitoring technologies that are able to deliver the expected cost savings for maintenance and enable innovative structural design for metals and composites.

Description of the work

The project itself is split into three parts (Work Packages), of which Work Package 1 deals with the specifications, Work Package 2 with the technology development, and Work Package 3 with the application and validation tests. The project includes nine sensor and monitoring technologies of different natures, which, at the end of the project, have to prove their applicability with regard to the objectives and specifications set. Due to their different natures, not all the technologies will meet all of the objectives and specifications. However, all the objectives will be addressed and hopefully met by the different technologies involved. Providing different solutions to meeting the objectives will guarantee that the merging of different technologies into one system will still be possible in the end, and that this will lead to a system meeting all of the objectives being addressed. It is possible that none of the technologies presented are able to meet the objectives set at this stage. The monitoring technologies to be proved are:

- Fibre Optic Bragg Gratings
- Sensitive Coatings
- Environmental Degradation Monitoring Sensors
- μ-wave Antennas
- Acousto-Ultrasonics
- Comparative Vacuum Measurement
- Acoustic Emission
- Imaging Ultrasonics
- Eddy Current Foil Systems

Expected results

The main innovation through SMIST will be to equip aero-structures with an integrated sensing function by adaptation of advanced sensor technologies to SHM systems, with the SHM systems being ready to be adapted to virtually any type of real aircraft structure and under a real in-service environment.

Acronym:	SMIST
Contract No.:	AST4-CT-2005-516103
Instrument:	Specific Targeted Research Project
Total Cost:	€5 882 799
EU Contribution:	€3 230 000
Starting Date:	01/05/2005
Duration:	36 months
Coordinator:	Airbus Deutschland GmbH Dept. Testing Technology (ESWNG) Huenefeldstrasse 1-5 DE-28199 Bremen,
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Partners:

EADS CCR	FR
EADS Deutschland GmbH	DE
Airbus France S.A.S.	FR
Airbus UK Ltd.	UK
Airbus Deutschland GmbH	DE
Alenia Aeronautica S.p.A.	IT
Dassault Aviation S.A.	FR
Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
Airbus España S.L.	ES
BAE SYSTEMS (Operations) Ltd.	UK
NDT Expert	FR
ARC Seibersdorf research GmbH	AT
University of Sheffield	UK

TATEM

Technologies and Techniques for New Maintenance Concepts

Background

The TATEM project investigates 'Technologies and Techniques for New Maintenance Concepts'. The project was born from a need to reduce the cost of maintenance in the face of increasing sophistication in aircraft and aircraft systems. It brings together a consortium of 58 contractors from 12 countries across Europe, Israel and Australia. The project is led by Smiths Aerospace Electronic Systems, Cheltenham.

Project objectives

Maintenance activities can account for as much as 20% of an operator's direct operating costs and have remained at this level for many years. However, there is scope for increasing the efficiency of the maintenance process. For example, it is estimated that line mechanics spend 30% of their time trying to access information to diagnose and rectify failures, and errors in the maintenance process can impact on aircraft safety. In a recent survey, the incidence of human error during maintenance tasks has been estimated to contribute to 15% of aircraft accidents. The occurrence of the need for unscheduled maintenance can introduce costly delays and cancellations if the problem cannot be rectified in a timely manner.

The objective of the TATEM project is to develop and validate philosophies, technologies and techniques, which can be used to transfer unscheduled maintenance to scheduled maintenance. By taking this approach, the projects aims to show the means to achieve a 20% reduction in airline operating costs within ten years and a 50% reduction over 20 years.

Description of the work

Maintenance engineers often work under severe time pressure on complex problems and in difficult physical conditions, which requires access to detailed information to diagnose and repair problems. Such factors mean that effective research into aircraft maintenance must take a multidisciplinary approach to address the technical and human related challenges.

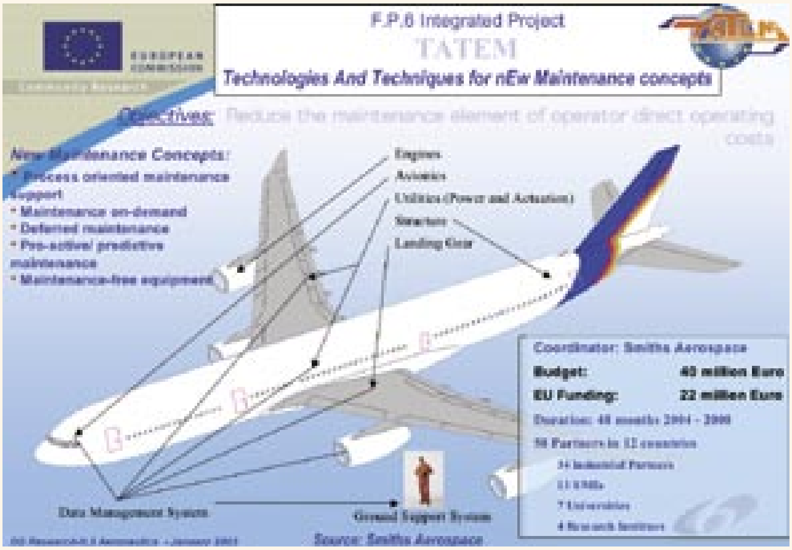
TATEM takes a holistic view towards maintenance across the aircraft and investigates all aspects of 'on-aircraft' and 'off-aircraft' maintenance issues. The technical focus of the project is to assess the following maintenance philosophies, technologies and techniques:

- Maintenance-free avionics that require no scheduled maintenance work.
- Signal processing techniques (e.g. fuzzy logic, neural networks, model-based reasoning), which can be used to convert data into information about the health of the systems.
- Novel on-board sensor technology to gather data from the aircraft (avionics, utilities, actuation, engines and structures), to feed prognostic or diagnostic systems.
- Diagnostic methods to identify and locate failures and malfunctions and so reduce the incidence of 'no fault found' alarms.
- Prognostic methods to provide support for preventative maintenance actions.
- Decision support techniques to generate process-orientated information and guidance (instructions) for the maintenance engineer.
- Human interface technologies to provide the ground crew with information, data and advice at the point of work.

The aim in the first year of the project has been to understand the strengths and weaknesses of the current maintenance 'approach'. The aim in years 2 and 3 of the project is to develop the maintenance philosophies, technologies and techniques that can achieve the desired cost reductions. The most promising of these will be integrated into a large physical demonstration(s) in the fourth year of the project. This will provide the means for validating whether the project has been successful in its aims of reducing maintenance costs.

Expected results

For the industrial contractors, a successful outcome of the project's objective will potentially yield new ways of doing business, and provide radical changes to aircraft operation and maintenance philosophy, new product opportunities and the formation of new partnerships and collaboration. The academic contractors will support these outcomes by significantly contributing to the scientific and intellectual challenges of the project.



Acronym:	TATEM
Contract No.:	AIP3-CT-2004-502909
Instrument:	Integrated Project
Total Cost:	€39 936 044
EU Contribution:	€21 932 083
Starting Date:	01/03/2004
Duration:	48 months
Website:	http://www.tatemproject.com

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Alenia Aeronautica S.p.A.	IT
ATCT Industries Ltd.	IL
Avitronics Research	EL
ENTECH	EL
EADS Deutschland GmbH	DE
Eurocopter S.A.S.	FR
Gamesa Desarrollos Aeronáuticos S.A.	ES
Hispano-Suiza S.A.	FR
Israel Aircraft Industries Ltd. (IAI)	IL
Institutul Pentru Analiza Sistemlor S.A.	RO
Integrated Aerospace Sciences Corporation O.E. (INASCO)	EL
Instituto de Soldadura e Qualidade (ISQ)	PT
Institute of Structures and Advanced Materials (ISTRAM)	EL
3D Vision	FR
Messier-Dowty Ltd.	UK
MTU Aero Engines GmbH	DE
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
National Technical University of Athens (NTUA)	EL
Paragon Ltd.	EL
RSL Electronics Ltd.	IL
SAFRAN S.A.	FR
Sinters	FR
Techspace Aero S.A.	BE
Fundación Tekniker	ES
THALES Avionics S.A.	FR
University of Bristol	UK
Hellenic Aerospace Industry S.A.	EL
BAE SYSTEMS (Operations) Ltd.	UK
Galileo Avionica S.p.A.	IT
Diehl Avionik Systeme GmbH	DE
Airbus UK Ltd.	UK
Airbus Deutschland GmbH	DE
Selenia Communications S.p.A.	IT
Societa' Italiana Avionica S.p.A	IT
Technische Universität Darmstadt	DE

DaimlerChrysler AG	DE
Aerosystems International Ltd.	UK
University of Patras	EL
Trinity College Dublin	IE
EADS Sogerma Services	FR
Skytek Ltd.	IE
THALES Avionics Electrical Systems S.A.	FR
University of Central Lancashire	UK
University of Sheffield	UK
Airbus España S.L.	ES
SR Technics Ireland Ltd	IE
INCODEV S.A.	FR
International STAR Training (IST)	FR
Centre National de la Recherche Scientifique (CNRS)	FR
EADS CCR	FR
Cooperative Research Centre for Advanced Composite Structures Ltd.	AUS
NDT Expert	FR
Air France	FR

SAFEE

Security of Aircraft in the Future European Environment

Background

SAFEE is a large, integrated project designed to restore full confidence in the air transport industry. The overall vision for SAFEE is the construction of advanced aircraft security systems designed to prevent on-board threats. The main goal of these systems is to ensure a fully secure flight from departure to arrival destination, whatever the identified threats are.

Project objectives

The project's baseline is the assumption that upstream identification control and airport specific security measures have all been completed. The project focuses on the implementation of a wide spectrum of threat sensing systems, and the corresponding response actions against physical person(s) or electronic intruders. One of the key aspects of the project is an integrated information management system underpinned by a secure communication system.

One of the short-term goals of SAFEE is to influence security bodies at national level, at European level (proposal to Documentation 30 of ECAC-CEAC) and at world level (proposal to Annex 17 of ICAO-OACI).

Description of the work

For reaching these objectives, SAFEE has five key activities (Sub-Projects):

1. Onboard Threat Detection System (OTDS): an integrated threat detection system based on processing multiple sensor information is being elaborated, prototyped and evaluated.
2. Threat Assessment and Response Management System (TARMS): an integrated information management system and decision support tool.
3. Flight reconfiguration: includes an Emergency Avoidance System (EAS) and an automatic guidance system to control the aircraft for a safe return.
4. Data Protection System (DPS) securing all the data exchanges (in and out of the aircraft).
5. Security evaluation activities, including legal and regulatory issues about citizens' privacy and rights, economic analysis, and dissemination activities.

The proponents are major European industrial actors of the aeronautical sector associated with a high-level research centre, several relevant SMEs and some specialised universities. For obvious reasons, a certain degree of confidentiality on proposed sensors and technologies will, be imposed on the obtained results.

Expected achievements

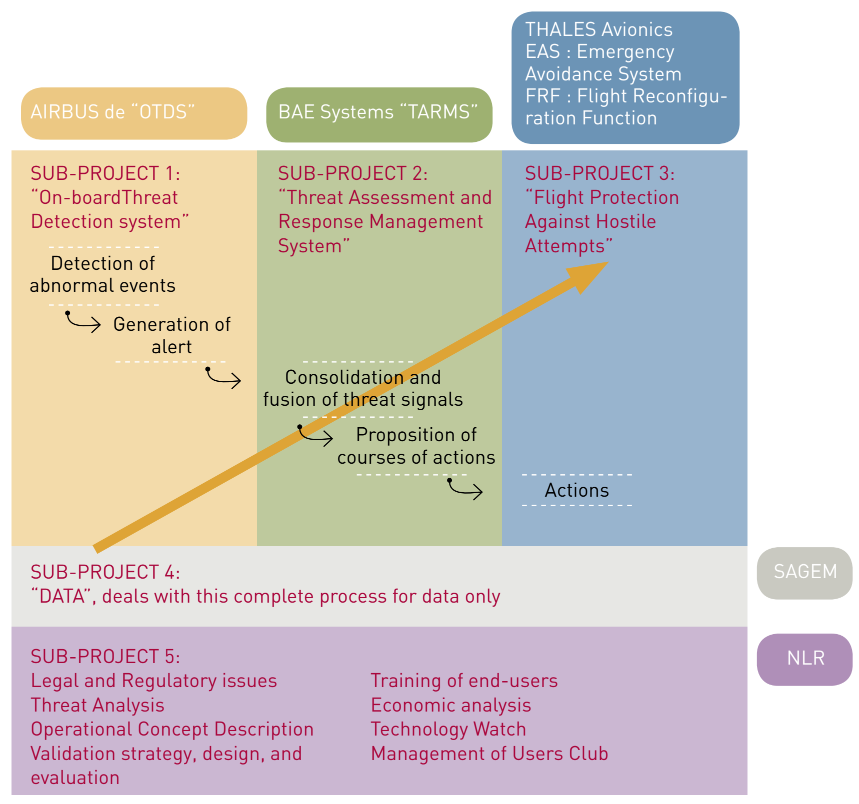
Demonstration of SAFEE systems will be performed at three sites:

The evaluation campaigns of the Onboard Threat Detection System (OTDS) will be conducted in a mock-up of an Airbus aircraft cabin at Airbus' Hamburg site.

The final demonstration of TARMS will be built around the existing GRACE cockpit simulator at NLR in Amsterdam.

The capability of EAS will be demonstrated on a Thales-Avionics simulator in Toulouse.

The DPS securing all the data exchanges will be validated at each site where it is possible to demonstrate it.



Acronym: SAFEE

Contract No.: AIP3-CT-2003-503521

Instrument: Integrated Project

Total Cost: €35 870 412

EU Contribution: €19 450 976

Starting Date: 01/02/2004

Duration: 48 months

Website: secure web site with password access

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Partners:	SAFRAN S.A.	FR
	Airbus France S.A.S.	FR
	Airbus Deutschland GmbH	DE
	BAE SYSTEMS (Operations) Ltd.	UK
	THALES Avionics S.A.	FR
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Global Security Services Solutions Ltd. (GS-3)	IL
	Selenia Communications S.p.A.	IT
	SITA Information Networking Computing B.V.	NL
	EADS CCR	FR
	EADS Deutschland GmbH	DE
	Ingenieria de Sistemas para la Defensa de Enpaña S.A. (ISDEFE)	ES
	Galileo Avionica S.p.A.	IT
	Bundesanstalt für Materialforschung und Materialprüfung (BAM)	DE
	Hellenic Aerospace Industry S.A.	EL
	Airtel ATN Ltd.	IE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	Skysoft Portugal – Software e Tecnologias de Informaçao S.A.	PT
	Siemens Gebäudesicherheit GmbH	DE
	Rockwell-Collins France	FR
	SODIELEC S.A.	FR
	Cenciarini & Co. s.r.l.	IT
	Informatique, Electromagnétisme, Electronique, Analyse Numérique (IEEA)	FR
	Environics OY	FI
	Miriad Technologies S.A.	FR
	ECORYS Nederland B.V.	NL
	Technische Universität München (TUM)	DE
	University of Reading	UK
	Centre de Diffusion des Technologies de l'Information S.A. (CEDITI)	BE
	ENERTEC S.A.	FR
	Teleavio, Consorzio Telecommunicazioni Avionica s.r.l.	IT

ASAS-TN2

Airborne Separation Assistance System – Thematic Network 2

Background

At the 11th Air Navigation Conference, the International Civil Aviation Organisation recommended that States support the cost-effective, early implementation of packages of ground and airborne ADS-B (Automatic Dependent Surveillance-Broadcasting) applications (ASAS), noting the early achievable benefits from these new ATM applications. The provision and processing of surveillance information to flight crew by ASAS has the potential to affect all ATM stakeholders. The first ASAS-TN project (Fifth Framework Programme) produced an implementation strategy and the first steps towards ASAS applications, which are part of the first ADS-B package. TN2 will extend the scope of this work to include all ASAS applications and will produce annual reports on the state of affairs in all activities relating to ASAS. This information will be supplemented, disseminated and underpinned by focused discussions captured during five themed workshops held during the course of the project.

Project objectives

The main goal of the ASAS Thematic Network 2 (ASAS-TN2) is to accelerate the application of ASAS operations in European Airspace considering global applicability, in order to increase airspace capacity and safety.

The main project objective is to ease the transfer and comparison of information and results on ASAS research in order to improve the research strategy, in particular to making recommendations.

The following sub-objectives have been identified:

1. to facilitate the exchange of ideas, to provide a framework for discussion and to ease the dissemination of information
2. to provide a database of ASAS-related documents to support studies and projects
3. to facilitate coordination of ongoing RTD (Research and Technical Development) projects related to ASAS, and specifically between ground and airborne orientated projects
4. to facilitate consensus for standardisation and certification
5. to provide guidance and recommendations for future ASAS strategy including RTD, technical feasibility, validation and implementation
6. to present and discuss information and results with stakeholders.

Description of the work

The main ASAS Thematic Network 2 outputs consist of sharing the current knowledge on ASAS/ADS-B between all European stakeholders and in recommending future activities necessary to obtain operational use of ASAS applications.

Distributed air and ground responsibilities involve ground ATC sharing the responsibility for separation provision with aircraft suitably equipped to ensure their own separation from other aircraft, thereby reducing ground ATC workload and enhancing flight efficiency.

The ASAS-TN2 project is divided into four work packages:

– Work Package 0: ASAS-TN2 Management: Work Package 0 concerns the management of the Co-ordination Action.

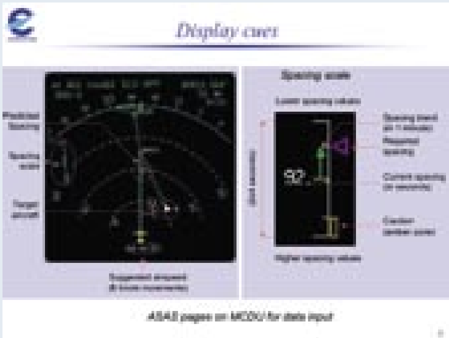
- Work Package 1: ASAS-TN2 Workshops and Seminars: In Work Package 1, six events will be organised on ASAS topics for the RTD community but also for the ATM stakeholders.
- Work Package 2: ASAS-TN2 Internet and Document Repository: Work Package 2 ASAS/ADS-B related documents will be made publicly available
- Work Package 3: ASAS-TN2 'Tableau de Bord' and Reports: Work Package 3 is focused on delivering a yearly status report on the progress towards the implementation of ASAS/ADS-B applications.

Expected results

To reinforce co-operation on ASAS, it is proposed:

- to organise workshops on topics related to ASAS applications
- to organise a seminar to present RTD results on ASAS applications open to all stakeholders
- to maintain an ASAS repository where all the documents related to ASAS could be identified and downloaded
- to develop periodic reports on the status of standardisation, certification and implementation of ASAS applications.

The ATM Master Plan, the Eurocontrol CASCADE Programme, and, in the short term, the Sixth Framework Programme and TEN-T projects like C-ATM, NUP2+ and SEAP shall directly benefit from the shared information, the consensus obtained and the recommendations made.



Acronym:	ASAS-TN2	
Contract No.:	ACA4-CT-2005-012213	
Instrument:	Coordination Action	
Total Cost:	€1 937 415	
EU Contribution:	€1 937 415	
Staring date:	01/04/ 2005	
Duration:	36 months	
Website:	www.asas-tn.org	
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Partners:	Eurocontrol - European Organisation for the Safety of Air Navigation	INT
	BAE SYSTEMS (Operations) Ltd.	UK
	ENAV S.p.A.	IT
	LUFTFARTSVERKET (Swedish Civil Aviation Administration)	SE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	THALES ATM S.A.	FR
	THALES Avionics S.A.	FR

ASSTAR

Advanced Safe Separation Technologies and Algorithms

Background

Air transport around the world, but particularly in Europe, is experiencing major capacity, efficiency and environmental challenges to improve performance. The Airborne Separation Assistance System (ASAS) uses ADS-B (Automatic Dependent Surveillance - Broadcast) data to provide improved airborne surveillance in support of new procedures for controllers and pilots. ASSTAR addresses these critical issues by researching and validating two areas of ASAS Package II that have strong potential for short term operational and environmental improvements.

Project objectives

The objective of ASSTAR is to perform research into the operational and safety aspects of introducing the following ASAS Package II applications in order to make the significant potential benefit to the user community a reality in the 2010 plus time frame:

- The delegation of conflict resolution manoeuvres to the air, in radar controlled airspace (i.e. crossing and passing), in order to reduce controller workload and improve flight efficiency.
- The use of ADS-B to support new operations in oceanic and other non-radar airspace, enabling more optimal routing, including enhanced use of wind corridors, and passing and level changing, which are currently severely restricted due to the procedural separation standards.

The two themes will be brought together in the procedural definition, air and ground implementation and key safety assessment tasks to deliver a coherent set of operational procedures and algorithms for implementation in a practical, beneficial, certifiable and cost-effective solution.

Description of the work

For each of the two themes, the operational concepts and scenarios will be identified, analysed and defined. Airborne Self-Separation procedure in non-radar oceanic airspace above a certain flight level in so-called Free Flight Airspace will be included. The design of the applications will involve defining the functional logic and algorithms. These designs will be optimised by studying candidate functional processes, algorithms and task distributions. The optimisation measures will be safety, implementation ability and airspace capacity benefits. The result will be a set of well-defined and preliminary-assessed ASAS functions.

The procedures will be specified, refined and then reviewed by controllers and pilots. The detailing of the procedures will aim to simplify further standardisation and facilitate early implementation. Preliminary training requirements will be specified to facilitate building human competence and confidence. The result will be a set of detailed procedures and training requirements.

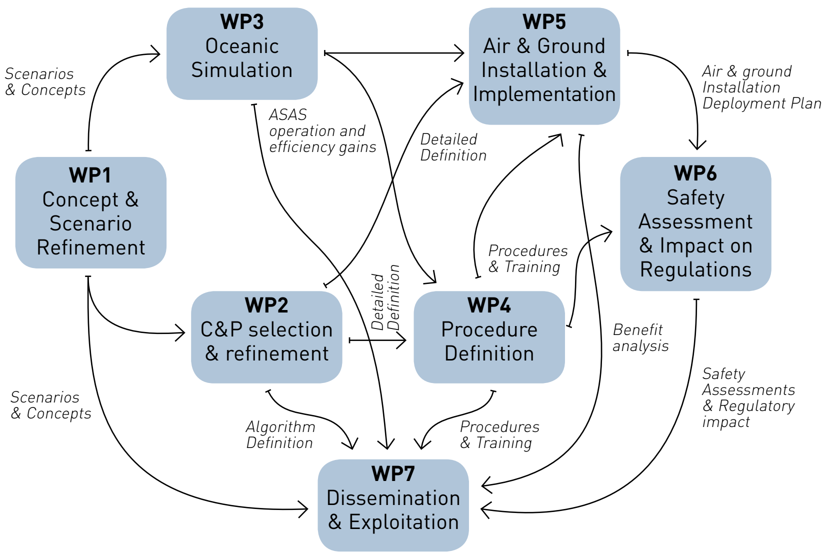
The air and ground infrastructure will be investigated, for both radar and non-radar scenarios. This activity will encompass elements of installation, certification and validation, resulting in a set of comprehensive deployment requirements. A benefits analysis, particularly in terms of the end users' business case, will be prepared.

Feedback on applications will be given from the safety perspective with respect to hardware, software, human factors, environment and the interaction of these various aspects. The result will be to establish a set of safety recommendations and requirements, in terms of data and system redundancy and integrity, separation standards, etc., leading to a set of verifiably safe applications.

Expected Achievements

The evaluation of these new applications will give an early determination of the air and ground difficulties, limitations, benefits and opportunities arising as a consequence of their introduction. This information on the airborne functionality and the accompanying ATC procedures will greatly benefit the future selection of advantageous ASAS functionality and will provide the template for future research into these advanced functions. Widespread dissemination of the results is planned.

ASSTAR Work Breakdown Structure and Workflow



Acronym:	ASSTAR	
Contract No.:	AST4-CT-2005-516140	
Instrument:	Specific Targeted Research Project	
Total Cost:	€4 349 977	
EU Contribution:	€2 500 000	
Starting Date:	01/01/2005	
Duration:	30 months	
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EC Officer:	Jean-Luc Marchand Tel: +32 2 298 6619 Fax: +32 2 296 6757 E-mail: jean-luc.marchand@cec.eu.int	
Partners:	BAE SYSTEMS (Operations) Ltd.	UK
	Direction de la Navigation Aérienne (DNA)	FR
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Sistemi Innovativi per il Controllo del Traffico Aereo (SICTA)	IT
	Eurocontrol - European Organisation for the Safety of Air Navigation	FR
	THALES Avionics S.A.	FR
	Euro Telematik A.G.	DE
	University of Glasgow	UK
	Technological Educational Institute of Piraeus	EL
	University of Zilina	SK
	NATS (En Route) plc	UK
	Hellas Jet S.A.	EL

OPTIMAL

Optimised Procedures and Techniques for Improvement of Approach and Landing

Background

The major airports are increasingly capacity constrained, resulting in significant delays causing frustration and difficulties for both passengers and aircraft operators, and causing environmental problems. The compounded effects of more movements over longer periods of the day and night have increased the disturbance. This has fuelled the resistance of the population living near an airport against further expansion of the facility and its operations.

Project Objectives

OPTIMAL is an air-ground co-operative project, which is aiming to define and assess:

a) Innovative procedures for the approach and landing phases of aircraft and rotorcraft

b) New ATC tools and new airborne functions to support these new procedures.

The target timeframe for the operational implementation of OPTIMAL proposed procedures is 2010 and beyond, with an aim to enable stakeholders to:

- Increase the arrival rate at major airports significantly above the level achieved by current best practices
- Close the gap between capacity in low visibility conditions and good visibility conditions
- Allow aircraft/rotorcraft simultaneous operation to generate additional capacity
- Reduce the environmental impact by avoiding urban areas and by optimising noise and gas emissions during landing phases (such as Continuous Descent profiles)
- Accelerate the introduction of Approach Procedures with Vertical Guidance (APV)
- Take full advantage of the RNP-RNAV capabilities that are now available.
- Increase safety using vertical guidance
- Better accommodate commuter and general aviation aircraft.

Description of the work

OPTIMAL will design improvements of existing procedures using advanced technologies as well as new procedures:

Aircraft Procedures:

- (Advanced) Continuous Descent Approach (implementation of a specific vertical profile for noise abatement)
- ILS look-alike procedure
- Curved/Segmented approaches
- RNP 0.1 RNAV approach procedures
- Non-precision approaches
- Enablers: ILS, MLS, EVS, FLS, GBAS, SBAS.

Rotorcraft procedures:

- Specific IFR approach procedures based on GBAS, SBAS
- Steep / Curved / Segmented IFR approaches
- Simultaneous Non Interfering (SNI) IFR procedures
- Enablers: GBAS, SBAS.

OPTIMAL will validate a large number of procedures, as well as the related airborne and ground functions, by using powerful means such as:

- Flight tests for aircraft:

Procedure	Places	Aircraft	Purpose
Continuous Descent approach	Toulouse Bremen	A320 ATTAS	Airbus validation 4D advanced CDA
GBAS Cat I approach	Toulouse Málaga Málaga	A320 A320 Beechcraft	Local procedures
SBAS APV approach	San Sebastián	Beechcraft	Local procedures
RNP 0.1 Procedures	Toulouse	A320	Local procedures

- Flight tests for rotorcraft:

Procedure	Places	Rotorcraft	Purpose
IFR RNAV approach	Bremen	EC135	Advanced Interop by 4D guidance
SNI Steep approaches with GBAS	Toulouse	EC155	Local validation Interoperability
SNI Steep approaches with SBAS	Toulouse	EC155	Local validation Interoperability

- Real-time simulations for aircraft:

Procedure	Places	Means
Curved, segmented and RNP←0.3 RNP approaches	San Sebastián & Malaga	A340 simulator
EVS approaches Dual Threshold approaches	Frankfurt Frankfurt	D-cockpit + ATMOS+ATS
Advanced Continuous Descent approach	Schiphol	GRACE+ATC Sim

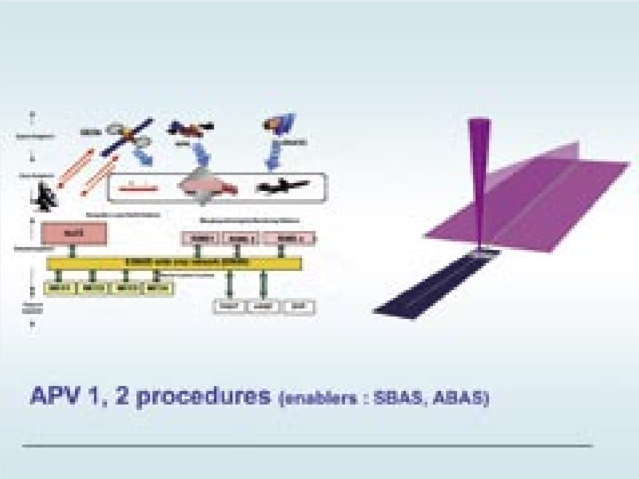
- Real-Time simulations for rotorcraft:

Procedure	Places	Means
SNI steep approaches	Toulouse / Schiphol	HPS + TRS + SPHERE
4D RNAV approach	Bremen	ATS+ATMOS+HELI-SIM

Validation exercises will be supported by an appropriate validation methodology with the aim of assessing whether the high level objectives (increased capacity, reduced environmental impacts while improving safety) are reached.

Expected results

- A consolidated/revised Eurocontrol operational concept that will support the implementation of the OPTIMAL advanced procedures
- A set of generic procedures, as well as the guidelines and recommendations to be used to detail them locally
- A set of detailed procedures for the particular airports considered in the project
- A significant contribution to normalisation and standardisation of procedures, as well as of airborne and ground systems.



Steep/Curved/Segmented and Simultaneous Non-Interfering Approaches are some of the topics investigated in OPTIMAL.

Acronym:	OPTIMAL
Contract No.:	AIP3-CT-2004-502880
Instrument:	Integrated Project
Total Cost:	€42 293 707
EU Contribution:	€21 991 855
Starting date:	01/02/2004
Duration:	48 months
Website:	www.optimal.isdefe.es
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EC Officer:	Marco Brusati Tel: +32 2 299 4848 Fax: +32 2 296 6757 E-mail: Marco.Brusati@cec.eu.int

Partners:	Airbus France S.A.S.	FR
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Ingenieria Y Economia del Transporte S.A. (INECO)	ES
	Eurocopter France S.A.S.	FR
	THALES ATM S.A	FR
	Ingenieria de Sistemas para la Defensa de Enpaña S.A. (ISDEFE)	ES
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Entidad Pública Empresarial Aeropuertos Españoles y Navegación Aérea (AENA)	ES
	Eurocontrol - European Organisation for the Safety of Air Navigation	INT
	THALES Avionics S.A.	FR
	Eurocopter Deutschland GmbH	DE
	Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
	University of Liverpool	UK
	Smiths Industries Aerospace & Defense Systems Ltd.	UK
	Agusta S.p.A.	IT
	DFS Deutsche Flugsicherung GmbH	DE
	Sociedad Estatal para las Enseñanzas Aeronauticas Civiles S.A.	ES
	Luchtverkeersleiding Nederland (LVNL)	NL
	Davidson Ltd.	UK
	GMV S.A.	ES
	Northrop Grumman Sperry Marine B.V.	UK
	ENAV S.p.A	IT
	Sistemi Innovativi per il Controllo del Traffico Aereo (SICTA)	IT

AVITRACK

Tracking of Aircraft Surroundings, Categorised Vehicles and Individuals for Apron's Activity Model Interpretation and Check

Background

AVITRACK uses state-of-the-art video systems and intelligent algorithms to track objects and persons, and to interpret normal aircraft servicing operations on the tarmac.

The AVITRACK project automatically checks the sequence and timing of movements on airport aprons. An assembly of cameras capture images of the aircraft parking zone, in which individuals, objects and vehicles can be identified then a computer programme interprets the real-time three-dimensional representation of activities and movements.

Project objectives

Making air transport more competitive

Aircraft are dependent on the availability of airport bays and airport handling efficiency. Delays produce a knock-on effect, which impacts on all airport traffic and, ultimately, economic performance. Part of AVITRACK's mission is to create a new management system that can optimise platform availability and thus reduce aircraft servicing costs.

Increasing capacity

It is now widely recognised within the air transport sector that major increases in operational capacity will only come through changes in the way air traffic services are provided. Helping airlines, handlers and airports to make the best use of available facilities is another goal of AVITRACK. The project will allow better information sharing between airport service providers and aircraft operators, accelerating the throughput of traffic and optimising the entire range of airport activities.

Description of the work

AVITRACK combines several innovative technologies:

1. Video tracking
   The assembly of cameras monitor the movements of individuals and vehicles around the aircraft. Image processing software detects movement in the scene. Detected objects are then classified as individuals, vehicles or mobile objects, all actors around the aircraft are detected and tracked, and vehicles are categorised by functionality (e.g. loader, truck, tanker, etc.). Multi-sensor data fusion is then used to create a real-time 3D representation map, which can be interpreted by the computer.

2. Apron Activities
   To achieve automatic recognition of the handling operations, the scene and the activities are modelled. A geometric model of the apron is formed, including the operational function of specific areas (like waiting area, ERA, tanker area, gateway evolution area, GPU area). The aircraft functional model, containing all potential contact points (like refuelling point, passenger doors, cargo doors, etc.) completes the 'apron

scenes and actors database'. This static apron representation is then combined with dynamic scenarios. (A scenario is a scheduled arrangement of basic and combined events.) Each event is the result of the semantic description of activities in connection with multiple individuals and vehicles around the aircraft. Using a dedicated ontology, the 'apron activities model' database covers a large part of all the handling operations.

3. Understanding AI
   Ground handling operation recognition process:
- The video-tracking module captures the activities around the aircraft.
- The 3D generated current situation map (people, aircraft and vehicle location) is combined with the 3D models of the apron area.
- This observed apron situation is compared to the 'apron activities model', using artificial intelligence technologies.
- Every operation and movement around the aircraft, from the simple to the more complex, is analysed and identified.
- All pertinent events are dispatched to the apron manager, airport authorities, airlines and security services.

Expected results

The AVITRACK supervision tool is designed for the benefit of the passengers. The system outputs are intended to be used by airport operators, handlers and security services to:
- manage identified actions undertaken for aircraft operations
- grant the Estimated Off Block-Time (EOTB)
- improve security
- manage the existing scarce airport capacity, and feature:
- connection with Departure Management Systems (DMA)
- interoperability between the Eurocontrol Central Flow Management Unit and aircraft operators
- apron allocation supervision.

Acronym:	AVITRACK	
Contract No.:	AST3-CT-2003-502818	
Instrument:	Specific Targeted Research Project	
Total Cost:	€2 600 268	
EU Contribution:	€1 557 163	
Starting Date:	01/02/2004	
Duration:	24 months	
Website :	www.avitrack.net	
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Partners:	SILOGIC S.A.	FR
	University of Reading	UK
	Institut National de Recherche en Informatique et en Automatique (INRIA)	FR
	Chambre de Commerce et d'Industrie de Toulouse Aéroport Toulouse-Blagnac	FR
	Fedespace	FR
	Euro Inter Toulouse	FR
	IKT System Partner A.S.	NO
	tekever lda	PT
	Technische Universität Wien	AT
	ARC Seibersdorf research GmbH	AT

EMMA

European Airport Movement Management by A-SMGCS

Background

Due to the growth in air transport, airport capacity is expected to become the major bottleneck in the near future. The EMMA project, together with the subsequent EMMA2, aims to provide the most significant R&D contribution to the Vision 2020 goals in the field of A-SMGCS (Advanced Surface Movement Guidance and Control System). This will be done in a four-year timeframe (from 2004 to 2008), by maturing and validating the A-SMGCS concept as an integrated air-ground system, seamlessly embedded in the overall ATM system. In a two-phase approach, EMMA will first consolidate the surveillance and conflict alert functions, and the successor project, EMMA2, will focus on advanced onboard guidance support to pilots and planning support to controllers.

Project objectives

The main objective of EMMA is to enable the harmonised A-SMGCS implementation at European airports. For this reason, it is important to bring together users, service providers, research organisations and manufacturers. The EMMA consortium was built from Air Navigation Service Providers, Airport Operators, the biggest group of Airline Operators, an Airframe Manufacturer, Avionics manufacturers, the main European ATM manufacturers and research establishments. A main extension of the A-SMGCS concept by EMMA will be the holistic, integrated air-ground approach, considering aircraft equipped with advanced systems for pilot assistance in a context where tower and apron controllers are supported by A-SMGCS ground systems. A mature technical and operational concept, as developed through EMMA, will ensure consistency of traffic information given to controllers and pilots. This is the basis for a common situation awareness and safe ground operations. The associated operational concept will define the roles and tasks of the onboard and ground stakeholders, and the procedures from an overall, holistic point of view. The development of conflict detection and resolution will not only increase safety but also efficiency.

Description of the work

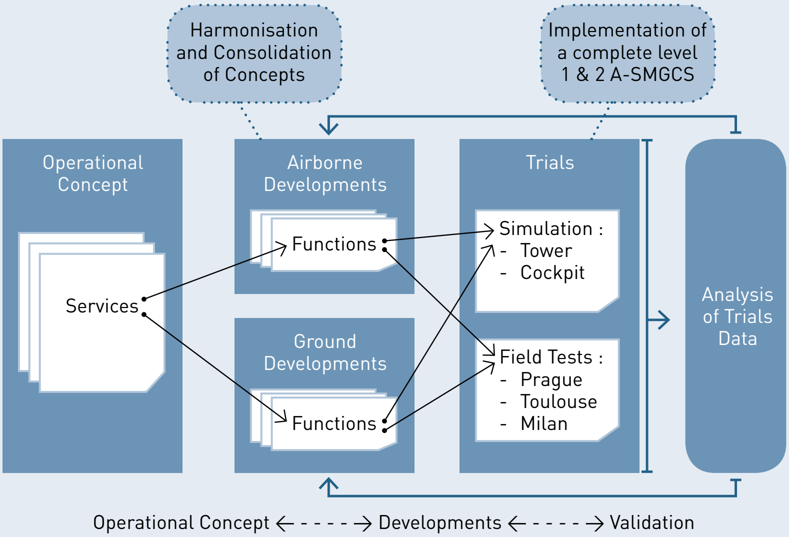
Based on an advanced operational concept, a level 1 and 2 A-SMGCS will be implemented at three European airports (Prague Ruzyne, Milan Malpensa and Toulouse-Blagnac) and will be in fully operational use for a relatively long time period. The project is following an iterative development process with system maturing phases followed by functional and operational testing phases. Two test campaigns are planned. Licensed controllers, as well as aircraft pilots and ground vehicle drivers, will be involved in testing in order to gain realistic, operation-focused results. Controllers and pilots will be trained in a simulated environment and on-site to prepare them to cope with a level 1 or 2 A-SMGCS under real operational conditions. The systems implemented are to be verified and validated against the predefined operational and technical requirements. On-site long-term trials at these test sites and at the busiest European hub in Paris are underway. The harmonised concepts of operations will be applied and validated due to functional and operational testing under real operational conditions. Active participation of licensed controllers and pilots from different countries are foreseen. Furthermore, activities more related to future A-SMGCS potential aspects are planned: through concept-studies, 'new A-SMGCS user' roles will be defined and tested in the successor project EMMA2. In addition, studies referring to 'data link situation in 2008+' and 'starter kits for regional airports' are to be conducted.

Expected results

The results of this test phase will provide feedback on the A-SMGCS ICAO Manual Doc. 9830 and are intended to be used for proposing standards for future implementation with:

- common operational procedures
- common technical and operational system performance
- common safety requirements, and
- common standards of interoperability with other ATM systems.

In order to meet the mentioned objectives, EMMA will build upon the previous work performed by EC projects, Eurocontrol and others. Finally, the Integrated Project EMMA will lead to comprehensive results, which will support the regulation and standardisation bodies as well as the industry in early and efficient implementation of A-SMGCS in Europe and beyond.



EMMA aims to seamlessly integrate the Advanced Surface Movement Guidance and Control System (A-SMGCS) concept into the air and ground operations of the ATM system. It will be tested in a simulated environment but also in three European airports.

Acronym:	EMMA
Contract No.:	TREN/04/FP6AE/S12.374991/503192
Instrument:	Integrated Project
Total Cost:	€16 094 869
EU Contribution:	€8 635 434

Starting Date:	29/03/2004	
Duration:	24 months	
Website:	www.dlr.de/emma	
Coordinator:	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Linder Höhe DE-51147 Köln	
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	Airbus France S.A.S.	FR
	Alenia Marconi Systems S.p.A.	IT
	Air Navigation Services of the Czech Republic	CZ
	BAE Systems Avionics Ltd.	UK
	Star Alliance Service GmbH (representing six European Airlines)	DE
	Direction de la Navigation Aérienne (DNA)	INT
	ENAV S.p.A.	IT
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
	Park Air Systems AS	NO
	THALES ATM S.p.A.	IT
	THALES Avionics S.A.	FR
	Aviation Hazard Analysis Ltd.	UK
	Research Centre of the Athens University of Economics and Business	EL
	eská správa leti, s.p. (Czech Airports Authority)	CZ
	Diehl Avionik Systeme GmbH	DE
	DFS Deutsche Flugsicherung GmbH	DE
	Eurocontrol - European Organisation for the Safety of Air Navigation	INT
	ERA a.s.	CZ
	EuroTelematik A.G.	DE
	Messier-Dowty Ltd.	UK
	Sistemi Innovativi per il Controllo del Traffico Aereo (SICTA)	IT
	Technische Universität Darmstadt	DE

OpTag

Improving Airport Efficiency, Security and Passenger Flow by Enhanced Passenger Monitoring

Background

Up to 5% of aircraft departure delays are caused by late passengers or late bags at the gate, and the impact of this in missed slots and subsequent costs will increase as the number of flights increases. The OpTag system will enable the immediate location of checked-in passengers who are either missing or late, and thus reduce passenger-induced delays and speed up aircraft turn around. The system could also form an essential component of Airline passenger identification and threat assessment systems through the automated identification of suspicious passenger movements or through the closer monitoring of individuals considered to pose a risk to secure operations.

Project objectives

There are three main developments required to create the OpTag system:

- A compact far-field radio frequency identification (RFID) tag and a reader capable of reading a large quantity of tags within its range without interference.
- A high-resolution, panoramic imaging system and corresponding software to follow a target and confirm the identity of the tagged individual or item. The system will be able to work over a network and allow different operators to select different views from the same camera.
- An ergonomic user interface to facilitate augmented surveillance, monitoring and targeting of individuals who may pose an economic or security risk to effective airport operations.

The security and efficiency environment of airports will also be researched so that the Optag system can be understood in context and developed to meet real requirements and with full understanding of the legal and operational factors and IP of the design.

Description of the Work

In order to achieve these objectives, the work will focus on:

Tag Development: A compact, active Tag will be developed with an expected range of at least 10 metres and which will work in conjunction with new readers to provide direction and range finding.

Camera Hardware Development: A digital camera system will be developed which will consist of 8 camera sensors mounted in a ring. The outputs from the sensors will be combined and processed to provide a single 360 degree high resolution panoramic image.

Image processing Software Development: Software will be developed which will process the output from the panoramic cameras and transmit the images over a network in such a way that individual views and zooms may be selected by a remote operators.

Final Integration and Airport Trial: A man-machine interface to control the image selection will be developed and trialed along with an interface to the Tag tracking system so that an operator can track and identify a person on a monitor view.

Four camera systems will be installed in a small airport so that experiments can be undertaken on the performance of the system in a real life environment.

Exploitation: covering IP management along with research into airport organisation. In addition, the legal and ethical framework of the operation of a passenger tracking system will be studied

Expected Achievements

The conclusion of the OpTag project is to be a live trial performed in an airport with passengers or other staff carrying tags and with optag cameras and tag readers networked to process the images and provide tracking and other information to an operator.

In addition, the team will have a knowledge of the likely requirements for the system, a plan for implementation and a clear understanding of the legal and ethical factors involved in implementation.

Acronym:	OpTag
Contract No.:	AST3-CT-2004-502858
Instrument:	Specific Targeted Research Project
Total Cost:	€2 212 971
EU Contribution:	€1 647 928
Starting Date:	01/02/2004
Duration:	36 months
Website:	http://www-research.ge.ucl.ac.uk/Optag/index.html
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Partners:

Innovision Research & Technology plc	UK
University College London (UCL)	UK
Longdin & Browning Surveys Ltd.	UK
Photonic Science Ltd.	UK
Telecommunication Systems Institute at Technical University of Crete	EL
Airport Debrecen KFT	HU
Europus Ltd.	UK
SLOT Consulting Ltd.	HU

SPADE

Supporting Platform for Airport Decision-Making and Efficiency Analysis

Background

A major challenge in the Strategic Research Agenda for European Aeronautics is for airports to be able to accommodate increasing traffic without undue delays, while preserving safety, improving efficiency and services, and reducing the burden of operations on the environment. This implies that airport stakeholders and policy-makers have to solve challenging airport decision-making problems with strong interdependencies and often conflicting objectives.

Project objectives

The objective of the SPADE project is to develop a user-friendly decision-support system for airport stakeholders and policy-makers. This system will provide support in airport development (both airside and landside), planning and operations, allowing integrated impact and trade-off analyses for a variety of performance measures (for example capacity, delay, level of service, safety, security, environmental impact and cost-benefits). It will address a number of important decisions (or 'use cases') regarding airport development, planning and operations via a pre-structured, pre-specified and guided 'wizard-type' human-machine interface in a single run, and in a back-office routine.

The SPADE project addresses Airport Efficiency, which is subdivided into two phases. The current phase (Phase 1) aims to develop a complete design of the decision-support system and to implement two mock-ups. By means of the mock-ups, a visual example of the system will be provided to potential users. The mock-ups will therefore be instrumental in presenting what the SPADE consortium expects as a result of Phase 2.

Description of the work

The development of the SPADE system is based on the concept of 'use cases'. A use case addresses a specific integrated airport impact or trade-off analysis by means of structured paths, built into the wizard-type model. The system will integrate a specific set of use cases.

The activities can be subdivided into two main streams. The first stream deals with the development of a complete system design and the second stream with the development of the two mock-ups.

The development of the complete design of the system follows the standard lifecycle and consists of five major and sequential activities:

1. Elicitation of use cases. Stakeholders involved in airport planning, operations and development process are identified in order to elicit their decision-support requirements systematically through interviews and a workshop. The system's decision-support framework is specified in terms of the use cases that will be provided.
2. Specification of the system. This concerns the system's components, the use cases (from the first activity) and their implementation in the system, and the airport data model in which all data will be managed.
3. Assessment of the functional specifications of the system against the use

cases. Any area where the specification does not cover the use cases is identified, and any enhancement required is implemented.

4. Design of the system. This concerns the system and its components, including the mechanism for the integration of tools, based on the system specification and possible enhancements.
5. Assessment of the system's design against the functional specification. This includes the carrying out of the relevant corrections and enhancements to the design.

The second stream of activities concerns the development of the two mock-ups. Each mock-up will be based on a use case identified in the activity above. The mock-ups will demonstrate computational capabilities, some functionality and the validity of the concepts behind the system. These are software implementations with the external appearance of the system, but not necessarily using a common platform for sharing modules in an integrated environment, or using a design similar to that of the final system.

Expected results

The first main result will be the complete design of the SPADE system. This design (together with the lessons to be learned in the development of the two mock-ups) will constitute the basis for the actual realisation of the system in Phase 2.

The second main result will be the creation of the two mock-ups, each based on a use case and using real airport data. The mock-ups will provide a visual example of the system to potential users and serve their key purpose of showing the validity of the concepts behind the system. The mock-ups will be instrumental in presenting what the consortium expects to be the results of Phase 2.

Acronym:	SPADE
Contract No.:	TREN/04/FP6AE/S07.29856/503207
Instrument:	Integrated Project
Total Cost:	€6 364 295
EU Contribution:	€3 898 901
Starting Date:	01/05/2004
Duration:	18 months
Website:	spade.nlr.nl
Organisation:	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR) Anthony Fokkerweg 2 NL-1059 CM Amsterdam
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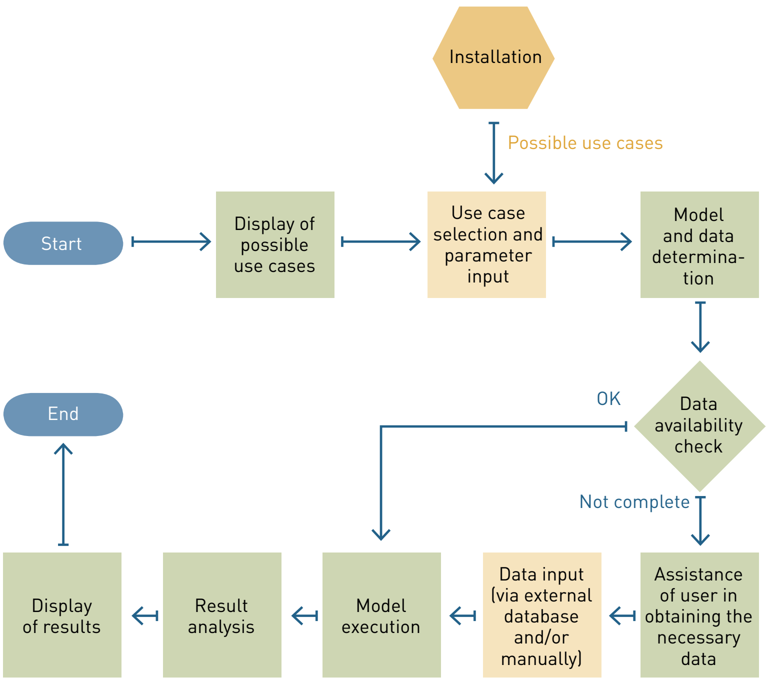
Partners:	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR) NL Entidad Pública Empresarial Aeropuertos Españoles y Navegación Aérea (AENA) ES Research Centre of Athens University of Economics and Business EL Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) DE International Air Transport Association (IATA) INT



Flowchart of the execution routine of the software developed in the SPADE project to provide automated decision-making capabilities in terms of airport efficiency issues such as safety, capacity, delays, quality of service, costs, etc.

Athens International Airport S.A.	EL
Airport Research Center GmbH	DE
Chambre de Commerce et d'Industrie de Toulouse Aéroport Toulouse-Blagnac	FR
Trasferimento di Tecnologia e Conoscenza S.C.p.A.	IT
ECORYS Nederland B.V.	NL
HITT N.V.	NL
Incontrol Management Consultants	NL
Ingenieria Y Economia del Transporte S.A. (INECO)	ES
Ingenieria de Sistemas para la Defensa de Enpaña S.A. (ISDEFE)	ES
Office National d'Etudes et de Recherches Aérospatiales (ONERA)	FR
Sistemi Innovativi per il Controllo del Traffico Aereo (SICTA)	IT
Technische Universiteit Delft	NL

B-VHF

Broadband VHF Aeronautical Communications System Based on MC-CDMA

Background

Air/ground communications are critical for achieving an ATM system that is capable of meeting air traffic demands in the future. Today's narrowband VHF technologies are using the VHF spectrum allocated for aeronautical safety communications in a highly inefficient manner. Spectrum efficiency could be improved by using broadband communications. The B-VHF project will investigate the feasibility of broadband multi-carrier (MC) technology combined with CDMA (Code Division Multiple Access) for VHF aeronautical communications.

Project objectives

The high-level goal of the B-VHF project is to prove the feasibility of the broadband MC-CDMA technology and demonstrate the benefits of this technology to the aeronautical community.

Additionally, the project will demonstrate that the B-VHF system has the capability to support an increased number of users within the same VHF spectrum while providing higher aggregate channel throughput than the sum of legacy systems occupying the same spectrum.

MC-CDMA technology can be easily adapted to various user needs and usage scenarios, providing various types of communications services to users' applications with different service attributes and quality of service expectations.

The preferred B-VHF deployment concept anticipates that the new system would be initially operated in parallel with the legacy narrowband VHF systems in a given area (overlay concept), virtually using the same part of the VHF spectrum without inter-system interference and without requiring additional spectral resources.

Description of work

Th tasks required to achieve these objectives are encapsulated into four separate Work Packages:

Work Package 0 Project Management and Quality Assurance: comprises activities that are essential to all Work Packages. It covers all management activities within the consortium and in particular the liaison with the European Commission.

Work Package 1 B-VHF System Aspects: produces high-level requirements for the B-VHF system, describes the reference aeronautical environment used in simulations of the B-VHF system, as well as the B-VHF Operational Concept. Work Package 1 will be closed after producing the B-VHF Deployment Scenario document. It will address technological, operational and institutional issues of the B-VHF initial deployment, transition and operational usage.

Work Package 2 VHF Band Compatibility Aspects: addresses the theoretical and practical assessment of probably the most critical aspect of the future B-VHF broadband system: its capability to be installed and operated, 'interweaved' with a number of legacy narrowband systems, sharing the same part of the VHF spectrum, but remaining robust against interference coming from such legacy narrowband VHF systems.

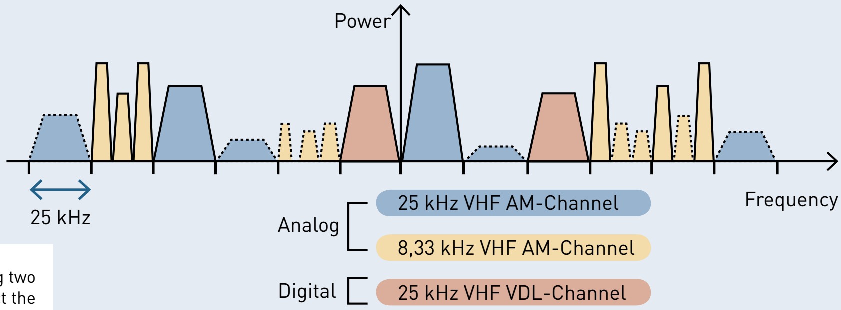
Work Package 3 B-VHF Design and Evaluation: covers B-VHF system detailed design tasks, starting with developing the model of the broadband VHF channel and proceeding with the development of the software representing the physical B-VHF layer, DLL (Dynamic Link Library) layer, higher protocol layers and representative aeronautical applications for the subsequent performance simulations.

Work Package 4 B-VHF Test bed: covers the base band implementation and evaluation of a test bed for both the forward and reverse B-VHF link. The implementation is restricted to the physical layer, which is the most critical part in the B-VHF system.

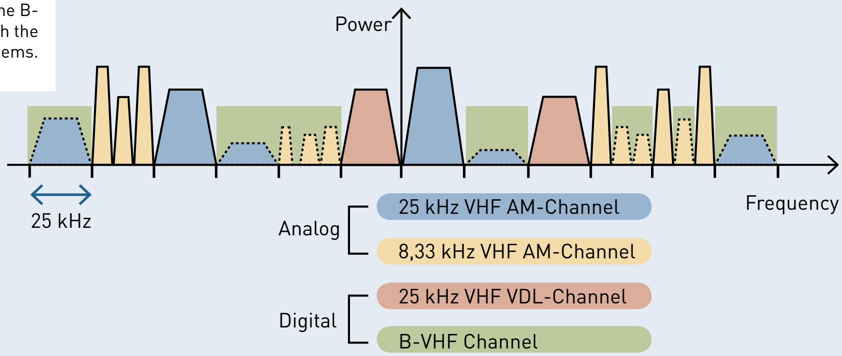
Expected results

The B-VHF system is expected to provide additional communications capacity by re-using the existing VHF COM spectrum, but without interference from legacy narrowband systems. The transition aspects shall be substantially easier than for any other known alternative. Spectrally efficient broadband B-VHF technology will provide capacity and performance for today's and future operational services and remove today's argument that the aeronautical spectrum is used in a very inefficient way.

The following two figures depict the current situation in the VHF COM band and the resulting VHF band occupancy, reflecting the co-existence of the B-VHF system with the legacy VHF systems.



The following two figures depict the current situation in the VHF COM band and the resulting VHF band occupancy, reflecting the co-existence of the B-VHF system with the legacy VHF systems.



Acronym:	B-VHF
Contract No.:	AST3-CT-2003-502910
Instrument:	Specific Targeted Research Project
Total Cost:	€2 913 939
EU Contribution:	€1 840 172
Starting Date:	01/01/2004
Duration:	30 months
Website:	www.b-vhf.org
Coordinator:	Frequentis GmbH Spittelbreitengasse 34 AT-1120 Vienna
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Partners:	Frequentis Nachrichtentechnik GmbH	DE
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	NATS (En Route) plc	UK
	Deutsche Lufthansa A.G.	DE
	BAE SYSTEMS (Operations) Ltd.	UK
	Scientific Generics Ltd.	UK
	Universiteit Gent	BE
	Universidad Politécnica de Madrid	ES
	Paris Lodron Universität Salzburg	AT
	DFS Deutsche Flugsicherung GmbH	DE
	Universidad de Las Palmas de Gran Canaria	ES

IFATS

Innovative Future Air Transport System

Background

Present studies concerning the future air transport system (ATS) generally propose generic operational concepts of keeping an organisation with two groups of human beings, some airborne, (the pilots), and others on the ground, (the controllers), trying to manage a complicated system through voice or digital messages, which are partially processed in real time by humans. Yet, the analysis of the causes of fatalities shows that, in many circumstances, human errors are dominant while technical progress gives the impression that machines could overrun human decisions in critical situations.

Project objectives

The IFATS project proposes to study a revolutionary concept for a future ATS by adding as much autonomy as necessary to both the aircraft and the ground control, to fulfil the overall requirements for improving efficiency and safety of air transportation.

The main goals of this project are:

- to define a technically viable concept of an ATS where aircraft would be operating automatically monitored by an automatic control supervised by ground operators
- to define autonomous operation procedures and optimise task sharing between the operators, the automated ground control system, the autonomous on-board computing system and an on-board engineer (if needed)
- to determine the minimum requirements and functionalities of the on-board system, to ensure safe operation in the case of communication loss with the ground control system;
- to perform safety analysis of the IFATS concepts and provide guidelines to certification issues
- to identify the difficulties that need to be overcome in order to build such an ATS, in both the technical and cultural aspects
- to find out an adequate level of automation for a future ATS
- to analyse a procedure to migrate from the present situation to the future ATS.

Description of the work

The IFATS project starts with an inventory of the existing ATS and a comprehensive survey of concepts and envisaged technologies to increase its performance and safety in the future. Based on this, a clear set of functional requirements is derived and the IFATS concept options are defined fully, developing the innovative idea of automating the ATS.

Once defined, the concepts have to be comprehended and the best option has to be selected. To this end, a modelling of the normal operations of the system is made. Additionally, the emergency or critical flight situations including ground/on-board interactions and communication failures are considered in a second phase.

In parallel to this modelling task, the various aspects of airworthiness, air traffic control and certification of the IFATS concepts as a whole are addressed. An analysis of the safety aspects of the concepts is done in order to prove that they are airworthy and operationally certifiable, while keeping or even improving the existing level of safety for the aircraft, for the passengers and crew and for the other vehicles using the neighbouring airspace. An iterative work is planned with the concept definition task in order to adjust the design to have a system fully compliant with the safety requirements.

Simulation is then used for the validation of the selected IFATS concept. This is done through the modelling of the traffic with a level of detail and a geographical dimension to be determined. The simulation has first to prove that the system is able to cope with the traffic that is expected in the timeframe considered in the project. Then the limits of the system are looked for, through an increase of the simulated traffic up to the saturation of the various components of the overall system.

The study of the social impact brought by this major modification of the ATS organisation, together with a thorough cost analysis of IFATS, will complete the information needed to conclude the viability of the concept.

A user group is also installed to inform the ATS community about the developed concepts and recommendations, and to get a fast response as to whether the proposed ATS concept is practicable.

Expected results

As it is difficult to define the way the present ATS will be modified, the IFATS approach has been proposed: the extreme solution of a system without any pilots or controllers will be evaluated in order to derive a technically and socially acceptable concept solution.

The results expected from the project are a comprehensive view of what this extreme system solution could be and a clear understanding of its benefits and drawbacks. From this assessment, recommendations will be made for future research and development aiming at making possible an evolution of the present ATS towards a future one able to withstand the forecast traffic growth.

Acronym: IFATS

Contract No.: AST3-CT-2004-503019

Instrument: Specific Targeted Research Project

Total Cost: €5 574 672

EU Contribution: €3 000 000

Starting Date: 01/07/2004

Duration: 30 months

Website: www.ifats-project.org

Co-ordinator: ONERA
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Partners:

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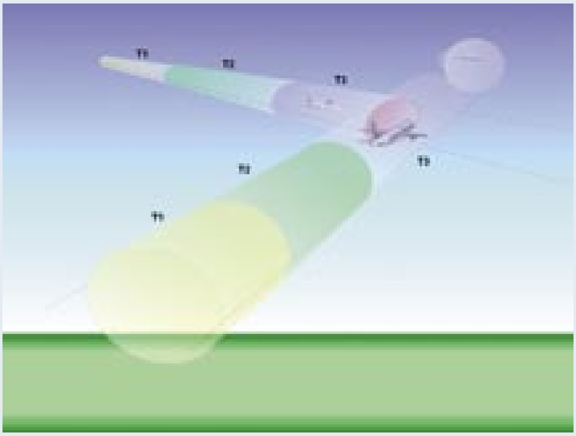
Israel Aircraft Industries Ltd. (IAI)	IL
THALES Communications S.A.	FR
Alenia Aeronautica S.p.A.	IT
Erdyn Consultants	FR
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
Centre d'Etudes de la Navigation Aérienne (CENA)	FR
Centro Italiano Ricerche Aerospaziali S.C.p.A. (CIRA)	IT
University of Patras	EL
Technion - Israel Institute of Technology	IL



AD4

4D Virtual Airspace Management System

Background

The management of air traffic (ATM) across the wide areas used in international routes is a growing problem with the increasing numbers of passengers and flights in operation. The systems used for ATM are adopting new technologies quite slowly and the modern controller is using working environments similar to those in use 30 years ago. Despite the fact that the management of air traffic is partly a three dimensional problem and the benefits of this have been discussed for a long time, no extensive use of 3D technologies has been made to date.

Project objectives

A new 4D technology, called D4 to differentiate it from the existing 4D ATM concept, will provide new ways for the controller to visualise and interact with information. Novel ways of representing the information will provide the opportunity to reduce knowledge gaps, supporting optimal decision-making. AD4 aims to build an innovative virtual airspace representation, supporting efficient ATM control systems where 3D interaction with air traffic/airport space is accessible to the controllers. It will explore the application of VR displays and 3D interaction technologies to provide an environment within which a controller can monitor a large number of aircraft over a wide area, being kept aware in real-time of the many complex factors in the control sector. The AD4 IT infrastructure, integrated with real ATM systems and simulation environments like, for example, ESCAPE, will enable the determination of the benefits, in terms of enhanced understanding and clarity of perception, that 3D displays and representations can provide to the controller.

Description of the Work

The AD4 project will address the analysis of operational concepts and human factors, as well as the engineering of the IT infrastructure and its core components (4D Human-Machine Interfaces, Middleware, Predictive and Applicative Components, interfaces to external data e.g. Meteo and ATM system integration), the development of a working demonstrator in an operational context, validation by use of the MAEVA 5th Framework Programme project methodology, and the assessment and exploitation of results.

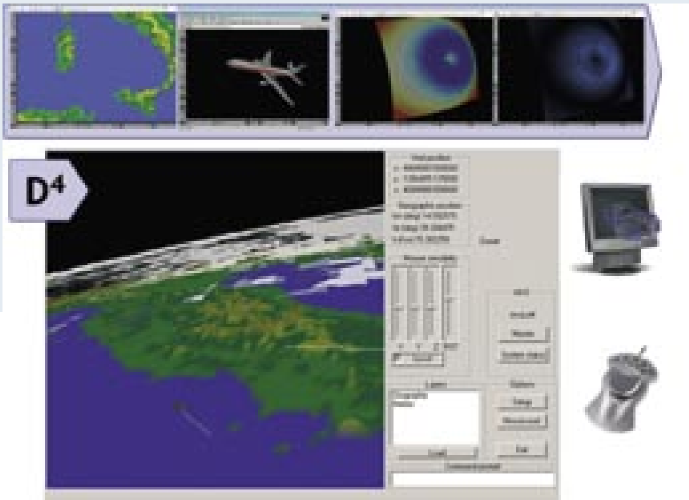
AD4 will be based on extensive re-use of a technology called D3 (D-Cube), developed in a successful national project, co-funded by the Italian Space Agency ASI. Such technology supports dynamic management and scalable data elaboration for Digital Elevation Models, meteorology, pressure and wind fields, radar tracks and telemetry data using auto-stereoscopic displays and 3D mouse devices. The AD4 system will be implemented in collaboration with experts in the field of ATM systems, virtual reality, and human factors supported by the Italian Agency for Air Navigation Services, ENAV, covering:

- a definition of the operational concepts and their expected impacts, including a review of the state-of-the-art technologies and systems
- a careful study of the major aspects related to the next generation 4D HMIs, driven by an extensive analysis of the human factors and an extensive assessment of safety and security aspects

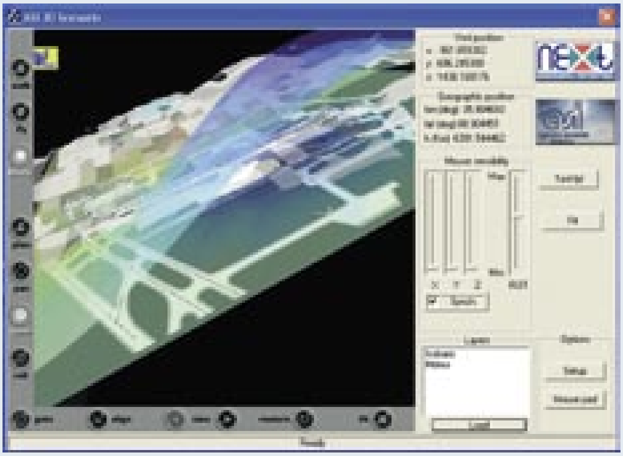
– the construction and on-site integration of a demonstrator in a real ATM control centre, tested by air traffic controllers
– two workshops, involving major players of the field and key users, to present preliminary results and the final outcomes of the AD4 project.

Expected results

The AD4 project will construct different releases of the IT infrastructure integrating 3D technologies and ATM components, driven by models using OMG-MDAs (Object Management Group Model Driven Architectures) and making use of Component Middleware (CORBA CCM). A final demonstrator will be hosted by a real ATM control centre and tested by air traffic controllers. Dissemination material will be published in a dedicated web site, http://www.ad4-project.com, to circulate important results in the relevant ATM communities.



Display of the En-route Flight Manager



Display of the Approach Flight Manager

Acronym:	AD4
Contract No.:	AST4-CT-2005-12328
Instrument:	Specific Targeted Research Project
Total Cost:	€3 502 926
EU Contribution:	€1 929 978
Starting Date:	01/01/2005
Duration:	24 months
Website:	http://www.ad4-project.com
Coordinator:	NEXT-Ingegneria dei Sistemi SpA Via Andrea Noale, 345B IT-00010 Rome
Contact:	Luigi Mazzucchelli Tel: +39 06 224 541 Fax: +39 06 224 54290 E-mail: luigi.mazzucchelli@next.it
EC Officer:	Jean-Luc Marchand Tel: +32 2 298 6619 Fax: +32 2296 6757 E-mail: jean-luc.marchand@cec.eu.int

Partners:	NEXT – Ingegneria dei Sistemi S.p.A.	IT
	ENAV S.p.A.	IT
	Vitrociset S.p.A.	IT
	Middlesex University Higher Education Corporation	UK
	Sistemi Innovativi per il Controllo del Traffico Aereo (SICTA)	IT
	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	DE
	ObjectSecurity Ltd.	UK
	Digital Video S.p.A.	IT
	Fundación European Software Institute (ESI)	ES
	Space Applications Services	BE

CAATS

Co-operative Approach to Air Traffic Services

Background

A paradigm shift in the way air traffic services are provided is required to achieve the implementation of the Single European Sky. To support this, research will integrate collaborative decision-making into a co-operative air and ground Air Traffic Management (ATM) end-to-end concept, validated in a complete ATM and Airport environment, whilst encouraging innovative research into a new paradigm supporting a more efficient Air Transport system. Some tasks are common across the different work areas, for example safety, human factors and validation, and there is a need to work towards a harmonised approach to these tasks. A Coordination Action will ensure that the management and dissemination of knowledge stemming from these common tasks obtains comparable results and avoids duplication of work across the following work areas:

- Co-operative ATM
- Advanced airborne system applications
- Reduced separation minima
- Airport efficiency
- ASMGCS
- Advanced approach and landing concepts
- Innovative ATM research.

Project objectives

The CAATS project aims to improve the coordination and support between Framework Programme 6 (FP6) projects in order to avoid disruptive and expensive overlapping. Knowledge will be gathered in these areas through close liaison with FP6 and Eurocontrol ATM-related projects in the areas of Safety, Human Factors and Validation. CAATS will further expand and refine the knowledge produced by the projects in the mentioned areas (avoiding overlapping and gaps). Knowledge will be consolidated by a small team of experts in the field and, based on all the information obtained in CAATS, best practice manuals will be produced. CAATS will also ensure that the new knowledge is made available to the ATM community through an active dissemination activity.

Description of the work

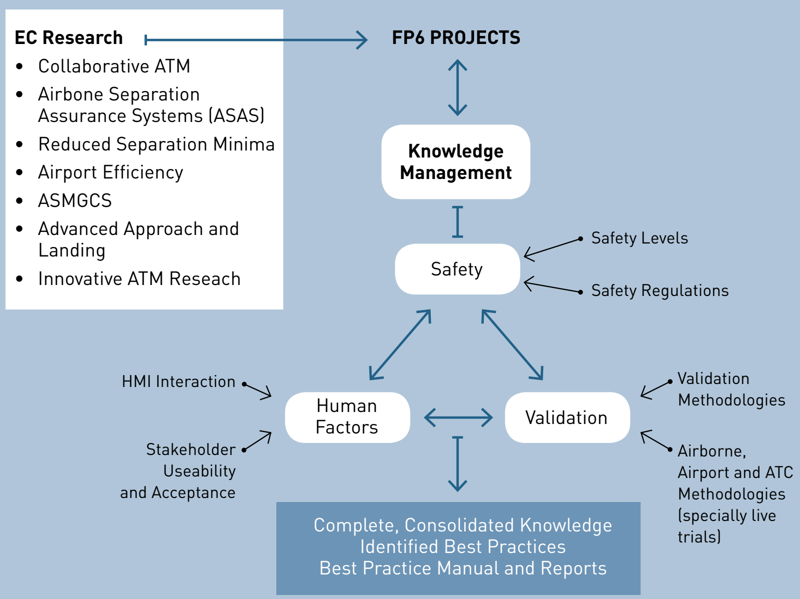
Specialised teams are performing tasks in three dedicated sub-Work Packages, and there is one team for each CAATS domain of interest: a Safety Team, a Human Factors Team and a Validation Team. The work is coordinated into an overall approach, consisting of the following:

- Knowledge audit, including knowledge from both within and beyond the actual FP6 and Eurocontrol projects.
- Gap analysis and filling, consisting of a review of the knowledge gathered, identification of any gaps in this knowledge, analysis of the information needed and identification of the best sources to fill these gaps.
- Identification of best practices based on all the knowledge obtained.
- Evolution and maintenance of best practices, informing users of any modifications.
- Preparation and dissemination of best practices to the ATM community and any other interested parties, through a newsletter, website, dissemination forums and any other suitable means.
- Coordination of a feedback process actively soliciting feedback in the course of dissemination activities, processing this feedback and making recommendations based on the feedback to improve best practices.
- Support to users as requested.

In addition to adopting this overall approach, each CAATS Team will maintain the flexibility to incorporate the specialised expertise of its individual members in each domain into the work to be accomplished.

Expected results

The expected result from the CAATS project is the production of the 'Best Practice Manuals' in the areas of Safety, Human Factors and Validation, based on gathered knowledge and the consolidation and evolution of this knowledge in close interaction with relevant FP6 projects. It is expected that projects, particularly new ones, will gradually arrive at a common approach in the mentioned areas. A wide dissemination of the knowledge will take place through Targeted Training Sessions (specific technical support), Dissemination Forums (to spread the knowledge and best practices), the project website and other suitable means.



Overview of the CAATS work plan. This Coordination Action aims to consolidate the knowledge obtained from FP6 projects on ATM Safety, Human Factors and Validation and to produce 'Best Practice' guides in these areas.

Acronym:	CAATS
Contract No.:	TREN/04/S/FP6TR/SI2.29891/Aero1/502791
Instrument:	Coordination Action
Total Cost:	€2 188 512
EU Contribution:	€2 000 000
Starting Date:	15/03/2004
Duration:	24 months
Website:	www.caats.isdefe.es
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Ingenieria de Sistemas para la Defensa de España S.A. (ISDEFE)	ES
Entidad Pública Empresarial Aeropuertos Españoles y Navegación Aérea (AENA)	ES
Eurocontrol - European Organisation for the Safety of Air Navigation	INT
NATS (En Route) Ltd.	UK
Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
Ingenieria Y Economia del Transporte S.A. (INECO)	ES
Deep Blue	IT
DEIMOS Space S.L.	ES
DFS Deutsche Flugsicherung GmbH	DE
Technische Universität Dresden	DE
Nickleby HFE Ltd.	UK
Research Centre of the Athens University of Economics and Business	EL
Slot Consulting Ltd.	HU
Centrum dopravního výzkumu	CZ

C-ATM
Co-operative Air Traffic Management

Background

The major challenges facing the European air transport system over the next 15-20 years include accommodating the predicted growth of air transport demand whilst providing a better, more predictable and more efficient service to airspace users, and maintaining or improving the overall safety of the system.

Such challenging objectives call for a combination of actions that will be targeted at discarding the inefficiencies of today's air traffic management modus operandi, eliminating segmentation and considering the Air Transport System as a whole. The aim of the C-ATM project is to contribute to these efforts.

Project objectives

C-ATM objectives are directed towards the elimination of the main obstacles facing the growth of the European Air Transport system over the next 20 years. The major challenge addressed by C-ATM is the dramatic improvement of the overall network efficiency, to provide a more reliable and predictable service to airspace users – particularly airlines – in order to support cost effective, on-time air transport services.

This will be achieved through the implementation of co-operative systems and processes aimed at optimising system resources and task distribution between air and ground, supported by the sharing of common data across the system.

The project places great importance on maintaining or improving the overall safety of the system. Environmental protection will be assured by the early identification of requirements to be incorporated into the system design process.

The C-ATM project aims to establish an unambiguous reference baseline facilitating the roll-out of improved, co-operative ATM operations in a 2012 time frame, thereby contributing to the Single European Sky implementation.

Description of the work

Phase 1 of the C-ATM Project was launched in May 2004 and has an 18-month duration. At the end of this phase, initial reference material will be delivered, including an operational concept and an associated technical baseline that will be further validated in subsequent projects.

C-ATM Phase 1 activities are organised in three main Work Packages:

Work Package 1 – Operational baseline led by EUROCONTROL

The main objective of Work Package 1 is to define the operational concept to be developed and implemented within the C-ATM project. The C-ATM operational concept will build upon mature elements of research developed in previous research programmes, integrating and consolidating these into an overall operational concept that is achievable in the target timeframe. In addition to identifying and documenting this concept and typical operational scenarios, the work package includes activities to analyse the cost-benefit and safety impacts of deploying the concept.

Work Package 2 –Technical baseline led by AIRBUS France

The main objective of Work Package 2 is to define high level functional and technical requirements of the airborne and ground applications supporting the operational concept, including interoperability issues. An initial generic specification will be defined and its impact on airborne and ground systems will be analysed, thus creating the technical baseline of the project. A specific activity will be dedicated to supporting standardisation of the selected solutions.

Work Package 3 – Roadmap and planning led by AENA

This Work Package will provide a general assessment of the potential deployment plan and implementation schedule of the concepts, procedures and applications defined in C-ATM (i.e. the roadmap and transition plans) and will establish a preliminary validation plan. Specific attention will be paid to certification issues, considering their impact on the implementation schedule.

C-ATM Phase 1 is coordinated by THALES Air Traffic Management who also have a leading role in Work Package 0 – Project Management Activities.

Work Package 0 includes project coordination activities, and project dissemination and communication activities. Project coordination activities consist of tasks linked to the management and coordination of the project at consortium level, administration and reporting to the European Commission.

Expected results

C-ATM Phase 1 will deliver an operational and technical reference baseline supported by an initial assessment of operational deployment roadmaps, while subsequent projects are envisaged to provide further supporting validation material.

The aim is for C-ATM Phase 1 output to become reference material defining cooperative ATM operations deployable in the 2012 timeframe. It will form a major input into subsequent R&D and validation projects, and into SESAME, thereby contributing to the Single European Sky implementation.

Acronym:	C-ATM
Contract No.:	TREN/04/FP6AE/S07.29954/502911
Instrument:	Integrated Project
Total Cost:	€9 178 219
EU Contribution:	€4 688 196
Starting Date:	05/04/2004
Duration:	18 months
Website:	www.c-atm.org
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	BAE SYSTEMS Avionics Ltd.	UK
	DFS Deutsche Flugsicherung GmbH	DE
	Deutsche Lufthansa A.G.	DE
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	DE
	Direction de la Navigation Aérienne (DNA)	INT
	Eurocontrol - European Organisation for the Safety of Air Navigation	INT
	Indra Sistemas	ES
	Ingenieria Y Economia del Transporte S.A. (INECO)	ES
	Ingenieria de Sistemas para la Defensa de Enpaña S.A. (ISDEFE)	ES
	Luftfartsverket (Swedish Civil Aviation Administration)	SE
	Stichting Nationaal Lucht- en Ruimtevaart Laboratorium (NLR)	NL
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	Société Française d'Etudes et de Réalisations d'Equipements Aéronautiques (SOFREAVIA)	FR
	THALES Avionics S.A.	FR
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