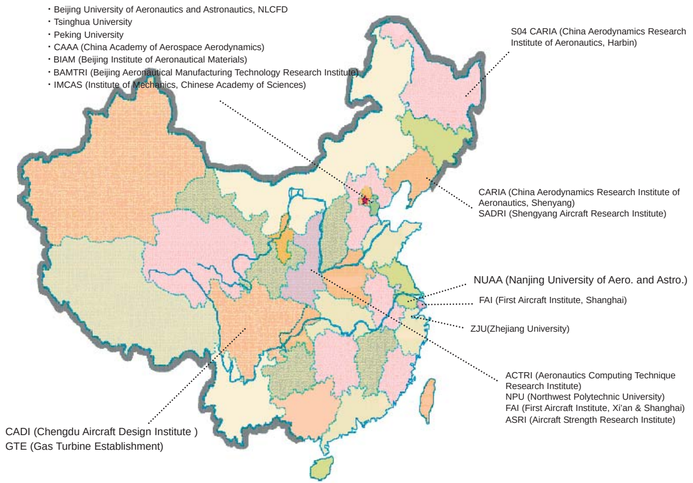
European and Chinese Maps

Consortium

European Participants		Chinese Participants
CIMNE	Spain	CAE
EADS IW	France	ACTRI
AIRBUS	Spain	CADI
ALENIA	Italy	NPU
IUSTI-UNIV.PROV.	France	CARIA
INRIA	France	SADRI
DLR	Germany	FAI
FOI	Sweden	BUAA
NUMECA	Belgium	TSINGHUA
UNIV. BIRMINGHAM	UK	UNIV.
UNIV. SHEFFIELD	UK	NUAA
IFTR	Poland	ZHEJIANG
INGENIA	Spain	UNIV.
		PEKING UNIV.
		CAAA
		ASRI
		BIAM
		GTE
		BAMTRI
		IMCAS



Challenge objectives

AEROCHINA2 is a 24 month project co-funded by the 7th Framework Programme of the European Community and by the China Aviation Industry Corporation (AVIC). It is managed by the European Commission as a Coordination and Support Action.

The aim of AEROCHINA2 is to foster the cooperation between a number of industry, university and research organizations in the aeronautics sector in Europe and China in the field of multi-physics modelling, computer simulation and code validation, experimental testing and design methods for the solution of multi-physics problems of interest to the aeronautic sector. The spectrum of multi-physical disciplines considered in AEROCHINA2 which are of interest of European and Chinese partners are Aerodynamics, Structures & Materials, Fluid Dynamics, Aeroacoustics, Active Flow Control and Aero Elasticity.

The general strategic objectives of the project are the following:

1. To identify areas of mutual RTD interest and the clarification of the skills, experiences and capabilities of the Chinese partners in the relevant technological areas of multi-physics analysis and design
2. To develop concepts of collaboration in those areas between the European and Chinese partners in order to ensure a win-win situation
3. To prepare specific RTD activities that are mature for joint proposals for FP7.

These AEROCHINA2 objectives correspond to a more long term preparation necessary for substantial and sustainable win-win cooperation in forthcoming FP7 calls.

Background

Numerous solvers, modelling, design optimisation and experimental tools have been developed and used until recently both in Europe (mainly though EC funded projects) and in China and have proven to be of significant value in many industrial applications, when not treating explicitly the coupling due to the multidisciplinary effects. So far, the correct use of such single discipline codes is limited to specific range of applications. Despite recent efforts, there is still a lack of initial information on available methods, codes and experiments related to loosely and strongly coupled multidisciplinary problems in aeronautics in Europe and China, involving two or more different fields (such as fluid/structure, fluid/acoustics, fluid/heat transfer, structure/acoustics, pollution flows, composite materials, etc....) and emphasizing the importance of human aspects and flexible integration on collaborative environments.

The aim of the AEROCHINA2 CSA is to identify and implement future collaboration between Europe and China for the solution of multidisciplinary design problems in aeronautics. This will be achieved by prospective studies aiming to collect, to store and to disseminate, on an individually or group basis, the existing knowledge in Europe and China in the field of multiphysics modelling, simulation, experimentation and design in aeronautics.

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AEROCHINA II

Courtesy of AVIC

Prospecting and promoting scientific cooperation between Europe and China in the field of multiphysics modelling, simulation, experimentation and design methods in aeronautics

http://www.cimne.com/aerochina2/

WG description

WG 1 - Aero-acoustics, noise and smart technology

Objectives
- To develop methods for CAA prediction, based on acoustic analogy, for tone and broadband noise
- To develop acoustic reduction techniques through better understanding of the noise generation mechanisms, for airframe noise, including theoretical developments in support
- To contribute to noise reduction through active control, such as:
  Casing treatment for fan noise; Frequency control related methods; Jet and vortex control systems
- To contribute to the development and application of measurement techniques for source localization and identification
- To investigate methodologies for optimization of combined noise and aero performance
- To investigate Smart methodologies, covering: Reduction of low frequency vibrations; Multiphysics modeling of these materials
  Testing of materials with active and passive implants for acoustic absorption.

Expertise of WG
- Numerical methods for aero-acoustic predictions
- Noise and vibro-acoustic large scale facilities for exterior and interior noise
- Noise measurement techniques
- Measurement techniques and prediction tools for vibro-acoustics

Multiphysics Topics
- Physics of vibration and acoustic propagation
- Fluid-structure interaction for coupling of material vibration and aero-acoustics
- Flow control techniques for noise reduction
- Multiphysics measurement techniques
- Large scale computing

List of participants

EU: **NUMECA,** DLR, FOI, IFTR

China: **ASRI,** FAI, CAAA, GTE

Topics of cooperation
- Acoustic reduction methodologies for airframe, jet and engine noise
- CAA prediction tools and related optimization methods
- Active noise reduction methods through flow control, including casing treatment for fan noise
- Jet and vortex control systems
- Development of vibro- and aeroacoustic measurement techniques for applications to control strategies

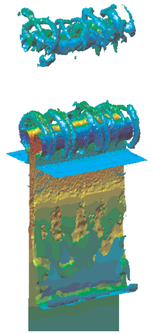
WG 2 - Flow Control

Objectives
- To control turbulent flow effectively from a more fundamental level by investigating directly the behaviour of Reynolds stress
- To conduct both computational simulations and experimental tests to extract reliable flow physics, for a number of active flow control devices, including (1) movable VG, dimples, bumps; (2) plasma; (3) synthetic jets.
- To explore large scale unsteadiness (unsteady jets, wakes and vortices) produced from these devices for effective turbulent flow control
- To apply and optimise these devices for separation control (higher shear, including lift enhancement), drag reduction (lower shear), acoustic characters of the flow control devices.

Expertise of WG

EU: URANS/DES/LES, optimisation, Case studies, Aero-acoustics, Design optimisation

China: URANS/LES, experimental methods, unsteady devices, Design optimisation, Plasma, CAA



Multiphysics Topics

Flow Control technologies including synthetic jets, micro-jets and active surfaces (bumps, dimples, movable VG) ; Active and passive flow controls Interaction of the plasma with flow field; Acoustic effects of flow control devices; Separation control, drag reduction, lift enhancement and noise reduction Multi-scale flow physics in flow control

List of participants

EU: **University of Sheffield**, AIRBUS, FOI, CIMNE, NUMECA, IUSTI, DLR

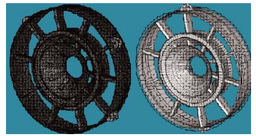
China: **NUAA,** CARIA, Tsinghua University, NPU, Peking University, BUAA, ACTRI

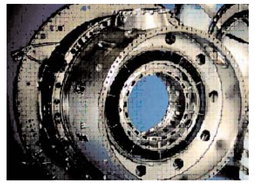
Topics of cooperation
- Experimental measurement techniques in flow control
- Computational simulation techniques in flow control
- Detailed investigation of Reynolds stress produced by various flow control means
- Consideration of flow interaction with unsteady forcing, plasma and acoustics

WG description

WG 3 - Aeroelasticity, Structures and Materials Applications

Objectives
- To Integrate and coordinate the industrial objectives of aircraft manufacturers in Europe and in China
- To Understand the influence of the materials characteristic on per formance of the wing and aircraft
- To exchange and transfer knowledge and expertise between research groups
- To set-up long-term partnerships and joint development activities, towards innovative aero-elastic prediction, control and optimization methods, contributing
- To improved international co-ordination of research and transnational technology development.
- To identify and validate new generation noise reduction technologies for aircraft, namely turbo-machinery, jet and airframe.





Expertise of WG
- Material's characterization and understanding
- Capability for casting of large Ti components
- Capability in modeling of casting process
- Capability in validation of the manufacturing processing

Multiphysics Topics
- Fluid structure interaction
- Water-cooled casting opeations
- Fluid-thermal interaction
- Rheology of materials

List of participants

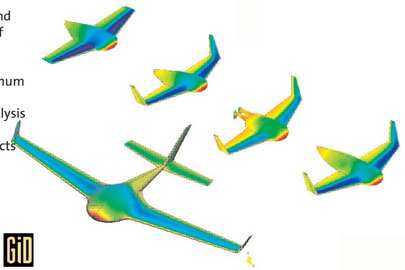
EU: **Univ. Birmingham**, EADS-IW, ALENIA, NUMECA, IFTR, INGENIA

China: **BIAM,** NPU, CARIA, Peking Univ., CAAA, ASRI, BAMTRI, IMCAS

Topics of cooperation
- Casting of large Ti structural components
- Static Aeroelastic Optimization Design Method on Large Aspect-ratio Wing
- New and fast method for aeroelastic predictions
- Structural Analysis
- Actively adaptive landing gears

WG 4 - Multi-Disciplinary Design Optimization and Validation

Objectives
- To consolidate collaboration between Chinese and European research groups in the development of improved tools for Multi-disciplinary Design Optimization (MDO).
- To improve capabilities of actually existing optimum design tools in an industrial environment.
- To collaborate in the validation of numerical analysis codes in the context of multi-physics analyses.
- To look for support for future collaborative projects between Chinese and European groups.



Expertise of WG
- Robust design methods.
- Evolutionary optimization algorithms.
- Mesh generation and mesh quality control.
- High performance computing.
- Industrial test cases.
- Multi-Level Algorithms

Multiphysics Topics
- Robust design with uncertainties
- Shape Optimum Design aerodynamic parts taking into account fluid-structure and/or fluid-thermal interaction.
- Multi-physics code validation.

List of participants

EU: **CIMNE,** EADS-IW, ALENIA, INRIA, University of Sheffield, NUMECA

China: **NPU,** ACTRI,CARIA, NUAA, CAAA

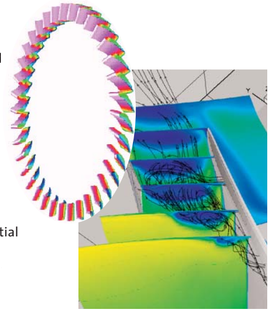
Topics of cooperation
- Tools for robust design with uncertainties.
- New parametrization schemes including the treatment of the computational meshes for its integration in the industrial design environment.
- Optimization software environment allowing to integrate different single- or multi-discipline analysis codes.
- Code validation in the context of MDO.
- Multi-physics code validation.

WG description

WG 5 - Propulsion Technologies and aero-thermal flows

Objectives

-To exchange and transfer knowledge and expertise between research groups.
-To collaborate in the validation of numerical analysis codes related to aero-acoustics, combustion, and aero-thermal modeling.
-To look for support for future collaborative projects between Chinese and European partners in the areas of propulsion and icing/de-icing/anti-icing.



Expertise of WG
- Flow and noise control for high performance turbine engines.
- Advanced open-rotor aerodynamics and aero-acoustics.
- Micro adaptive flow control for stator blades to develop potential smart turbine vanes.
- Low-pollution combustion technology for gas turbine engines.
- Accurate turbulent combustion interaction and spray models.
- Premixing fuel injection and ignition technology.
- Multistage vortical flow and two-phase flow modeling.

Multiphysics Topics
- Modeling aero-acoustics, combustion, aero-thermal flows and icing/de-icing/anti-icing.
- Micro adaptive flow control.
- Multi-physics code validation.

List of participants

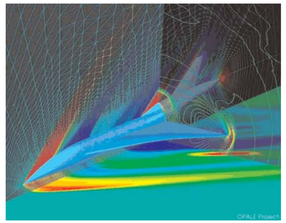
EU: **EADS-IW,** IUSTI Univ., NUMECA

China: **FAI,** GTE, Zhejiang Univ., Peking Univ., Tsinghua Univ., BUAA, CADI

Topics of cooperation
- Numerical modeling and experimental methods.
- Industrial case studies.
- Aircraft propulsion systems.
- Aircraft icing.

WG 6 - High Performance Computing

Objectives
- Collaboration of Chinese and European partners to master new flow control and optimisation technologies for use in future aircraft design and manufacturing
- Investment in enhancing the tools for large scale numerical simulation
- Contribute to the future "virtual prototyping and virtual certification" of commercial aircraft with all their multidisciplinary interactions in high-performance computing environments.



Expertise of WG
- Multiphysics modeling (reduced order models, ...)
- Robust and highly efficient algorithms for solving 3-D non linear equations (game theory, genetic algorithms, ...)
- Integrated multiphysics simulation tools
- Methods for uncertainties quantification and management
- Parallel, distributed and high-performance computing (supercomputers, large PC-clusters, ...)
- Efficient tools for handling and post processing the petascale volume of data resulting from simulation
- Competitive industry case studies and benchmarks

Multiphysics Topics
- Aeroelasticity, aeroacoustics, fluid-structure interaction
- Flight-tests management including petascale data management
- Multidiscipline collaborative frameworks
- Multi-objective robust optimization & uncertainty management
- High-performance computing including GPUs, supercomputers, multi-core & large clusters

List of participants

EU: **INRIA,** AIRBUS, ALENIA, BSC, CIMNE, EADS IW, NUMECA

China: **ACTRI,** NPU, Zhejiang Univ., NUAA

Topics of cooperation
- High-performance computing environments (including GPU, FPGA, multi-core architectures ...)
- Collaborative distributed platforms
- Frameworks for large-scale multidiscipline simulation and optimization