



An Overview of the Group for Aeronautical Research and Technology in EUROpe (GARTEUR)

Hervé CONSIGNY*, Council Chair

Olivier VASSEUR, Executive Committee Chair

Anne-Laure DELOT, GARTEUR Secretary

*: *speaker*

AIAA Paper 2014-0370





Outline

- Introduction
- The GARTEUR organization
- GARTEUR statistics
- Fields of scientific and technical activities
- Concluding remarks



Introduction

- Government-to-government agreement between France, Germany, Italy, the Netherlands, Spain, Sweden and United Kingdom
- GARTEUR objective is to improve competitiveness of aerospace industries by performing pre-competitive aeronautical research
- Participants: Research establishments, industry, academia
- Subjects of investigation cover civil and military R&T
- In harmony with other European R&T fora
- No exchange of money
- Based on mutual interest and global balance of contributions
- Flexible approach towards participation of European non-GARTEUR organizations



The GARTEUR organization

- GARTEUR Council:
 - Composed of representatives of member countries (National delegations)
 - Supported by an Executive Committee (one member per Nation) + Secretary
- GARTEUR Groups of Responsables:
 - Management and coordination of Action Groups
 - Promotion of research topics
 - Representatives from REs, industry and academia
 - Four fields of activities:
 - Aerodynamics (AD)
 - Flight Mechanics, Systems and Integration (FM)
 - Helicopters (HC)
 - Structures and Materials (SM)

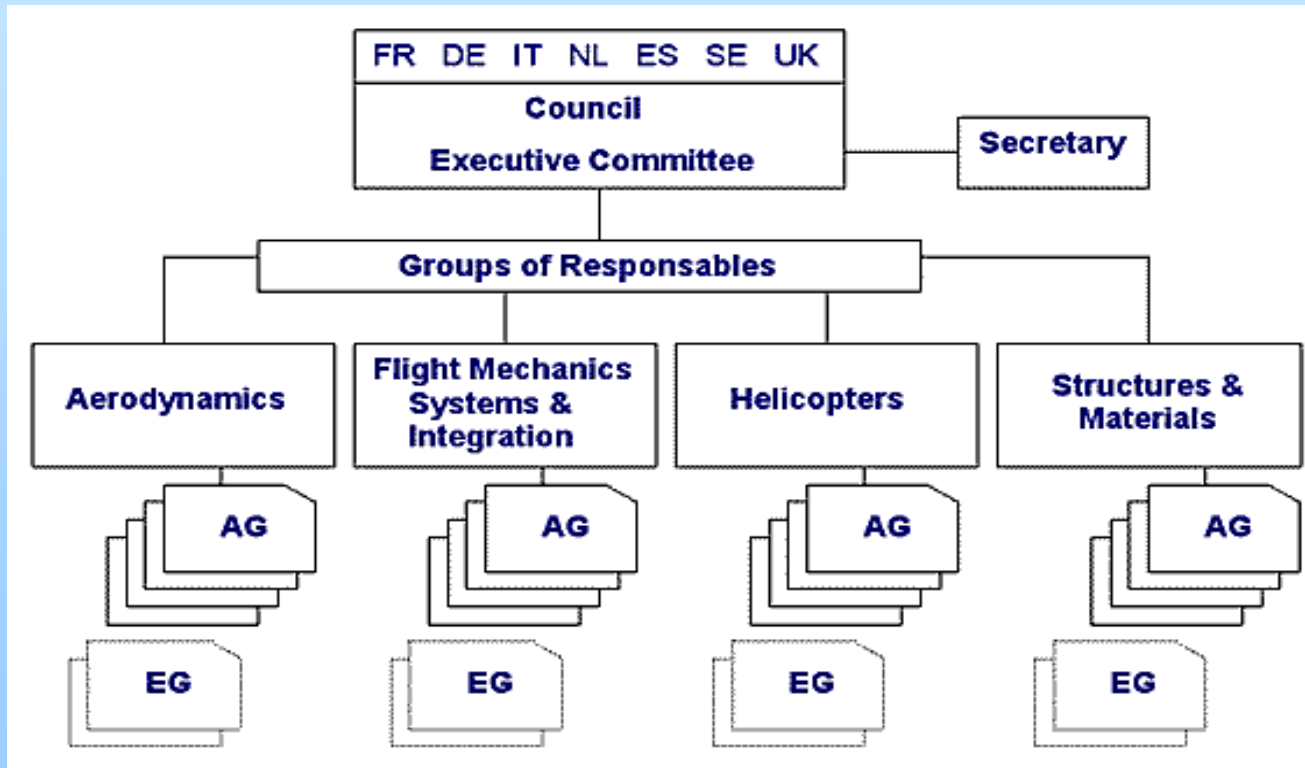


The GARTEUR organization

- GARTEUR Action Groups:
 - Technical expert bodies
 - Formulate research projects and execute the research work
 - Collaboration feasibility for potential research subjects investigated by **Exploratory Groups (EG)** to establish agreed proposals
 - Project eligibility: Participation from at least three GARTEUR countries

The GARTEUR organization

- GARTEUR is organized at three levels:





Outline

- Introduction
- The GARTEUR organization
- **GARTEUR statistics**
- Fields of scientific and technical activities
- Concluding remarks



GARTEUR statistics

- Since its formation GARTEUR has managed **more than 120 collaborative projects**:

- AD: 53
- FM: 19
- HC: 20
- SM: 35

- Participation in AGs by Nation (Year 2012)

	RE	Ind.	Univ.
FR	14	5	2
GE	12	6	6
IT	10	5	3
NL	12	2	2
SP	4	4	1
SW	6	5	1
UK	3	9	14



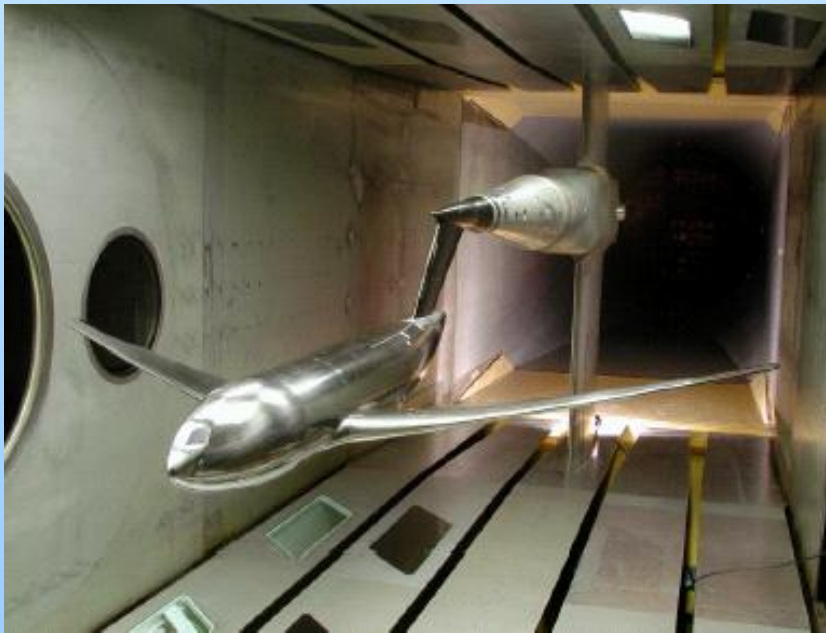
Outline

- Introduction
- The GARTEUR organization
- GARTEUR statistics
- Fields of scientific and technical activities
- Concluding remarks

Fields of scientific and technical activities

- GoR for Aerodynamics

- Covers aerodynamics, aeroacoustics and aerothermodynamics
- Is active in both experimental and computational fields



AS-28 model in DNW-HST

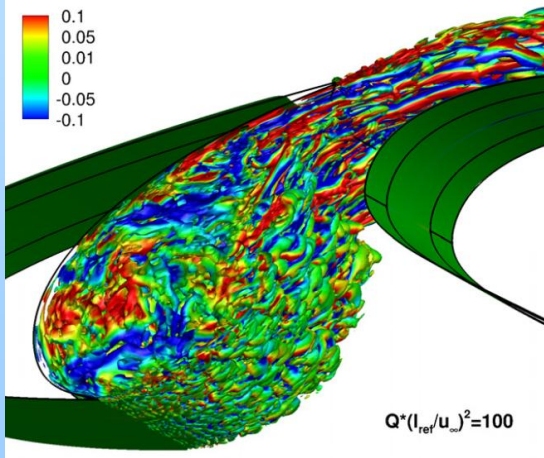
AD(AG) on "Transonic wing/body code validation experiment"

Fields of scientific and technical activities

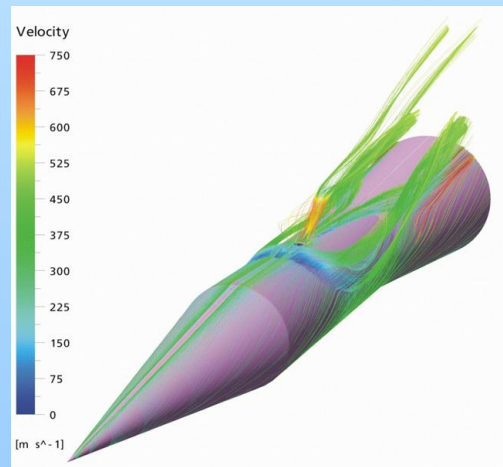
- GoR for Aerodynamics

- Examples of current projects are:

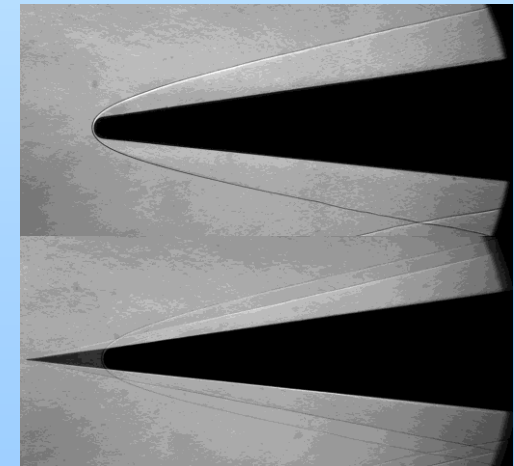
- ✓ Computations of the flow around high lift devices
- ✓ Prediction of cold-gas and hot-gas lateral jet interaction with missile cross-flow
- ✓ Transition in hypersonic flows



ZDES computation of a three-element aerofoil



Lateral jets interactions at supersonic speeds



Transition in hypersonic flows for sharp and blunt cones



Fields of scientific and technical activities

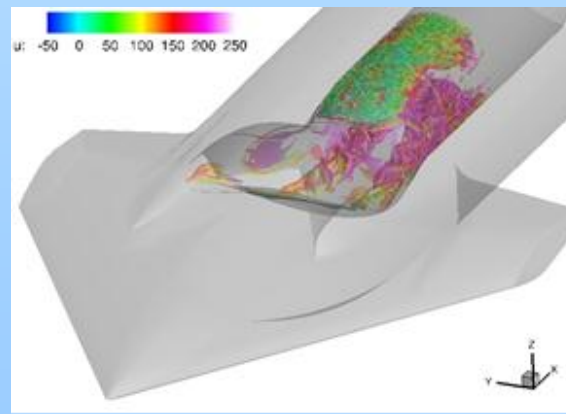
- GoR for Aerodynamics

- Example of activity: “Highly Integrated Subsonic Air Intakes” (AD/AG46):

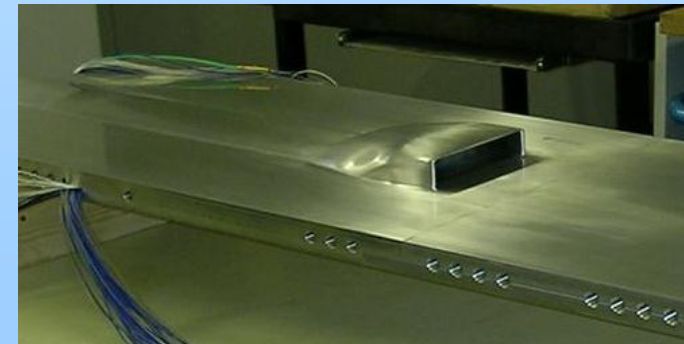
- ✓ Numerical simulations of unsteady internal flow in a subsonic air intake highly integrated into the airframe of a UAV applying different standard CFD methods and DES; validation of numerical simulations with wind tunnel test data
- ✓ Parametric studies of innovative intake configurations and basic experimental investigations addressing low-observable intake design issues for UAVs and contributing to a better understanding and correlation of installed performance predictions of highly integrated intake configurations



EIKON UAV model tested at FOI



ZDES computation for a UAV configuration



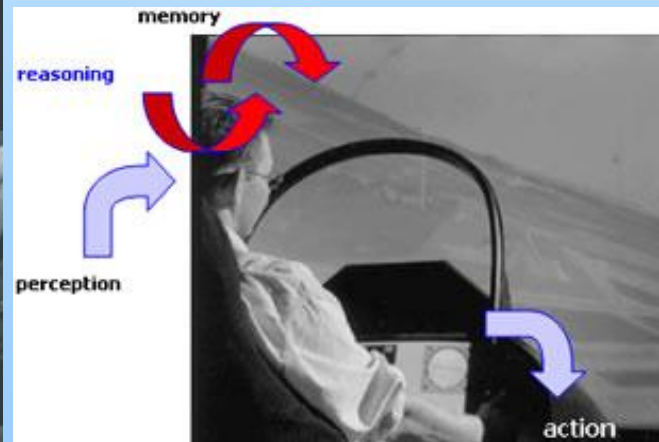
*Experimental parametric study of intake design
(cryogenic WT DNW-KRG at DLR)*

Fields of scientific and technical activities

- GoR for Flight Mechanics, Systems and Integration
 - Focuses on air vehicle systems technology (safety, avionics, certification, performance, stability & control)
 - Is active in flight testing technologies and flight simulations
 - Investigates air traffic control, sensor technology, systems and human factors



Flight-deck illustration



Human system



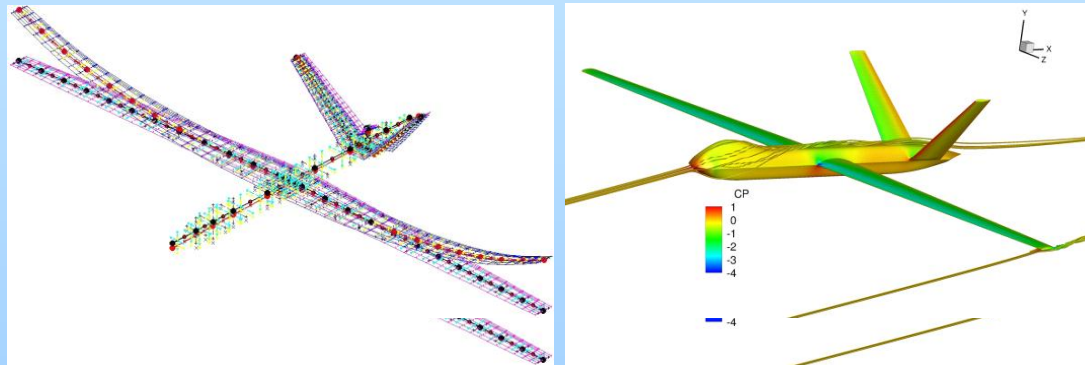
ONERA SV4 vertical wind tunnel and associated dynamic simulation test benches

Fields of scientific and technical activities

- GoR for Flight Mechanics, Systems and Integration

- Example of activity: “Flexible aircraft modeling methodologies” (FM/AG19)

- ✓ Objective: to generate integrated aerodynamic and aeroelastic models to be used in the flight control laws design of advanced flight control system.



*Flexible Aircraft
Modeling Methodologies*

- Future activities: 2 EGs, outputs from European projects, initiated in 2013:

- ✓ “Nonlinear Control Aircraft Benchmark” (FM/EG28) related to an EDA NICE project
- ✓ “Combined Formal Verification & Validation for trajectory conflicts” (FM/EG29) related to EDA/EREA project E4U

Fields of scientific and technical activities

- GoR for Helicopters

- Aims to facilitate the advancement of civil and military rotorcraft technology
- Seeks to extend the flight envelope and performance, to increase safety and survivability and to increase public acceptance
- Covers aerodynamics, aeroelasticity, flight mechanics, handling & control, flight tests & simulation and human factors



Rotor test rig and experimental rotor in QinetiQ 5 metre wind tunnel HC(AG) on "Validation of rotor blade / hub load synthesis techniques"

Fields of scientific and technical activities

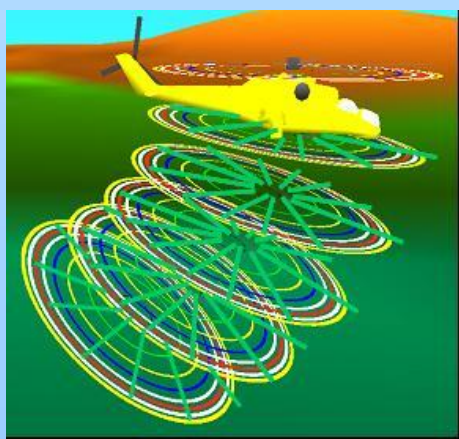
- GoR for Helicopters

- Example of activity: "Helicopter wakes models in the presence of ground obstacles" (HC/AG17):

- ✓ Study of the interaction between the wake dynamics and ground obstacles, buildings or super-structures that are close enough to the helicopter to affect the flow recirculation.

- ✓ Objectives of HC/AG17:

- Review and possibly improve methods for modeling wake interaction with ground obstacles
- Identify existing databases for the purposes of validation and arrange the data in order to allow partner organisations to correlate and improve there respective analytical models.

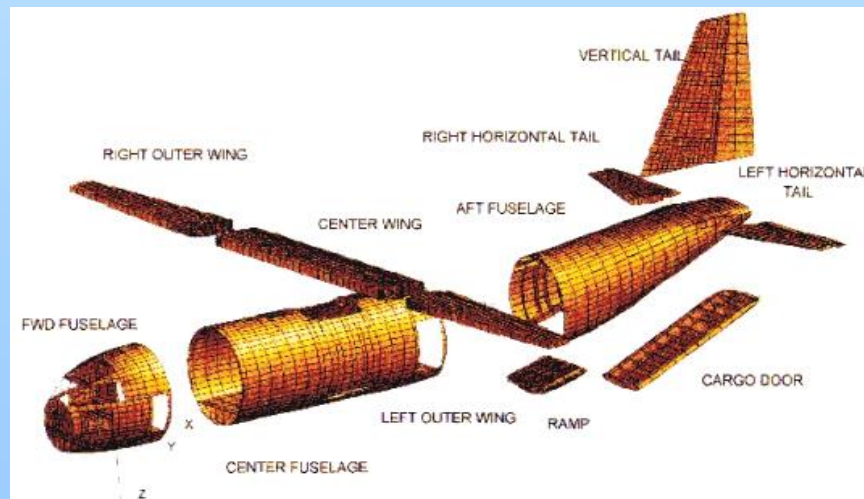


Multi-vortex rings rotor model

Fields of scientific and technical activities

- GoR for Structures and Materials

- Aeronautics-oriented research on structures, structural dynamics
- Computational mechanics, and loads and design methodology
- Vibrations, responses to shock and impact load, aeroelasticity and acoustic response
- Materials systems: metal, composites

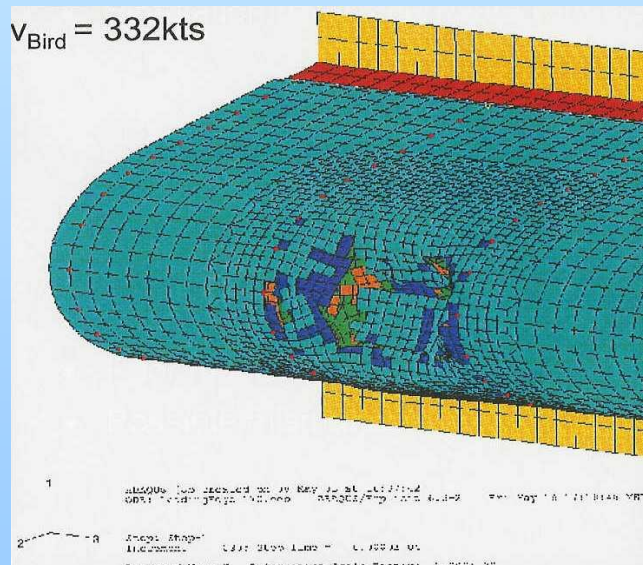


Fields of scientific and technical activities

- GoR for Structures and Materials

- Example of activity: "Impact damage and repair of composite structures":

- ✓ Development and validation of methods for the characterisation of impact damage in composite structures and investigation of bonded repairs



Computational modeling of bird strikes and experimental validation



Concluding remarks

- GARTEUR is a European multinational organization that performs high quality, collaborative, precompetitive research in the field of aeronautics
- Over the last 40 years, more than 120 collaborative projects were successfully conducted within GARTEUR
- Participants from seven European Nations are from research establishments, industry and academia
- GARTEUR is the only framework in Europe for both civil and military R&T: as such it is considered as a very valuable asset
- GARTEUR keeps contacts with other R&T fora (EU, EDA, NATO/STO, etc.)
- GARTEUR received the ICAS Von Kármán Award for International Co-operation in Aeronautics 2004:

“to honour all persons who contributed in the spirit of Theodore von Kármán’s vision on cross-border co-operation among scientists and engineers”