Overall view of the European Collaboration in Aeronautics Research Within GARTEUR

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*: speaker

CEAS 2015 paper no. 40
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
  - Five fields of activities:
    - Aerodynamics (AD)
    - Aviation Security (AS) new!
    - 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:
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• Since its formation GARTEUR has managed **more than 130 collaborative projects:**
  - AD: 55
  - FM: 19
  - HC: 23
  - SM: 35

• Participation in AGs by Nation (Year 2014)

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Fields of scientific and technical activities

- **GoR for Aerodynamics**
  - Covers aerodynamics, aero-acoustics, aero-elasticity, aero-thermodynamics, aerodynamic shape optimisation, aerodynamics coupled to flight mechanics
  - 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
    - Transition in hypersonic flows
    - Countermeasure aerodynamics: flares and chaff

  ![ZDES computation of a three-element aerofoil](image1)
  ![Transition in hypersonic flows for sharp and blunt cones](image2)
  ![Countermeasure aerodynamics](image3)

  - Use of flares to distract the enemy radar
  - Simulation of chaff concentration transport
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 Aviation Security**
  - **Security**: key issue in aeronautics (ACARE Challenge 4 “Ensuring safety and security“)
  - Group of Responsables in the field of “Aviation Security” launched in March 2014
  - Four major R&T domains
    - Cybersecurity
    - CBE (Chemical, Biological and Explosive) detection
    - Dazzling
    - Malevolent use of RPAS
  - Current work: define **Exploratory Groups** for each of these R&T domains to come up with proposals for Action Groups, as usually done in the other GoRs
  - **Position paper** of the GARTEUR community on the Aviation Security topic expected in 2015
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
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.
  - Future activities: 2 EGs, outputs from European projects:
    - “Non-linear flexible civil aircraft control methods evaluation benchmark” (FM/EG28) related to an EDA NICE project
    - “Trajectory Verification &Validation Methods: formal, auromatic control and geometric methods” (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, aero-elasticity, 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”](image1)

![AW609 TiltRotor](image2)

![Eurocopter X3](image3)
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 their respective analytical models

*Multi-vortex rings rotor model*
Fields of scientific and technical activities

- **GoR for Helicopters**
  - Example of activity: “Rotorcraft Simulation Fidelity Assessment: Predicted and Perceived Measures of Fidelity” (HC/AG21):
    - Objectives of HC/AG21:
      - Gain a better understanding of the various components that contribute to the definition and perception of rotorcraft simulation fidelity
      - Development of new criteria for fidelity assessment
      - Examination of the influence of the flight loop tolerances on predicted fidelity assessment together with an investigation of the role of simulator cueing on subjective or perceived fidelity assessment
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, aero-elasticity and acoustic response
  - Materials systems: metal, composites
Fields of scientific and technical activities

- **GoR for Structures and Materials**
  - Recent and current work is devoted to:
    - High velocity impact
    - Fatigue and damage tolerance assessment of hybrid structures
    - Damage repair in composite and metal structures
    - Bonded and bolted joints
    - Additive layer manufacturing

*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 130 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 in 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”