



# EASA

European Aviation Safety Agency

# Aircraft Certification and Simulation – Current Practice, Future Outlook and Challenges

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# Introduction - Certification of Aircraft

- All civil Aircraft must be certified by the EASA to be operated in Europe
- What is certification?
  - From the design to operations
  - Compliance demonstration to the applicable regulations
    - Aircraft > 7500kg : Certification Specification 25 (CS25)



# Introduction - Certification of Aircraft

## ➤ Basic Principles

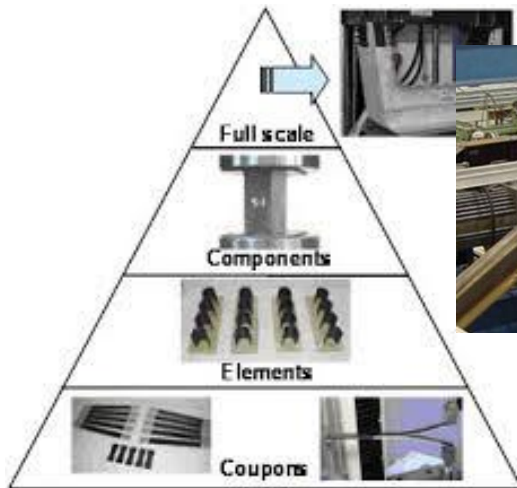
- Ensure Product Safety in its design envelope
- All analyses must be based on test data
  - CS 25.21 Proof of Compliance
    - By tests upon an aeroplane of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing
  - CS 25.571 Structure
  - CS 25.963 Fuel Tanks
- CS 25 currently requires a set of tests to certify an aircraft



# Introduction - Certification of Aircraft

## ➤ Testing includes

- Coupons, sub-assemblies, qualification, test benches, system integration tests – iron birds, mock up wind testing





# Introduction - Certification of Aircraft

► Testing includes complete A/C tests





# Introduction - Certification of Aircraft

- However, testing is
  - Costly
  - Time consuming
  - Subject to aleas

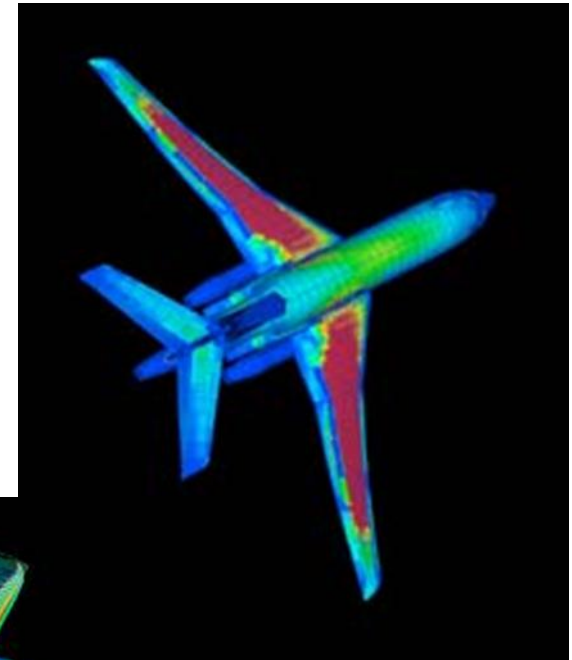
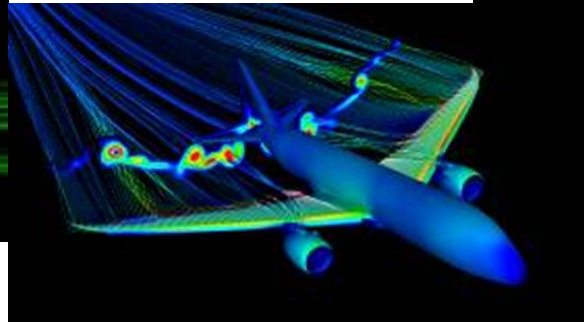
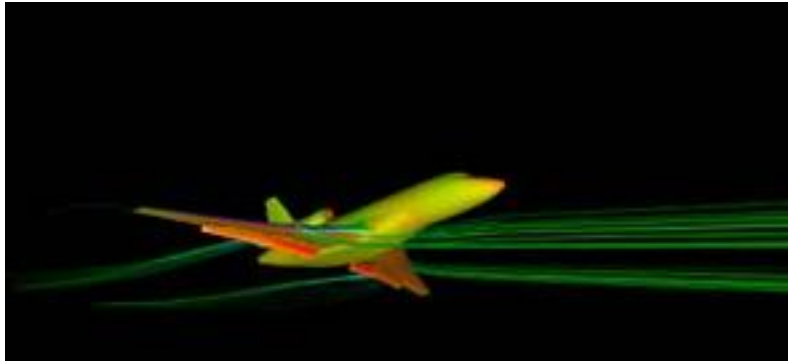


- Therefore, Simulation is today extensively used in aircraft design and in support of certification



# Simulation and Certification – Current Status

- Simulations are extensively used in Aviation
  - Preliminary Design phases
  - Development phase
  - Design phases
  - Compliance demonstration



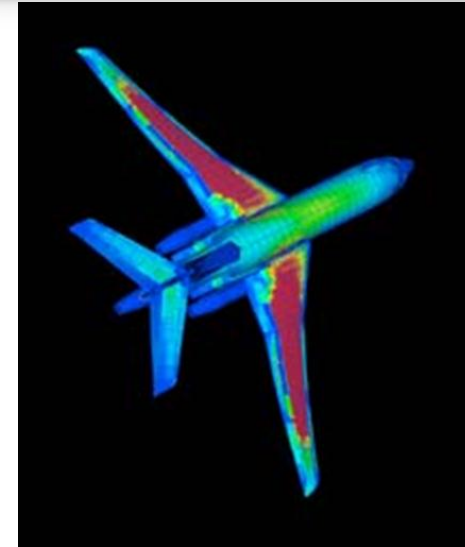


# Simulation and Certification – Current Status

## ➤ In particular

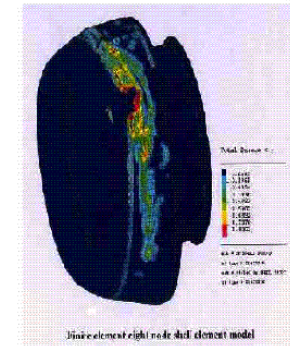
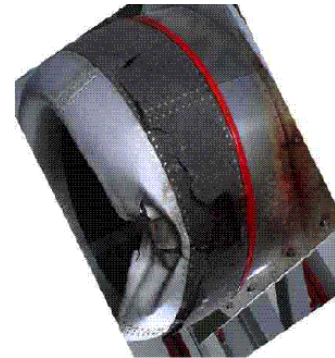
### ➤ Aerodynamics

- Clean configuration
- High lift configuration
- Ice accretion
- Performances



### ➤ Structures

- General models
- Detailed models



### ➤ Systems

- Matlab simulations or others





# Simulation and Certification – Current Status

- 1 model for each « case »
  - Structure model
  - Thermal model
  - Aerodynamic model
  - Electrical model
  - Hydraulic model
  
- Some tools are certified
  - Model based objects



# Simulation and Certification Future Outlook

- Simulation will
  - Be more and more extensively used
  - Be more and more integrated
    - Interaction systems/structure
    - Multiple systems integration simulation
    - Simulation of equipment/functions Failure (on going research WP in the frame of CleanSky2)
  - Integrate multiple simulations using one model
- More tools will be « certified »



# Certification and Simulation - Challenges

- Simulation is by nature a simplification of reality
  - A/C environment is very complex
  - A/C systems and structures are more and more interdependant
- Simulation relies on current knowledge
  - Cannot take into account non previsible aspects or behavior
  - Relies on Human perception of reality



# Certification and Simulation - Challenges

- Mitigation of simulation errors
  - Software
  - Human
- Avoid the « Yes compute » behavior
- Human Factors – Human in the loop simulations
  - This is becoming more and more important in aircraft design
- Training of staff
- Control of model outsourcing



# Potential areas of research

- Environment simulation
- « Universal » model
- Multiple model coupling
- Simulation tool certification
- Transient simulations improvements
- Human Factor aspects – human in the loop
- Database of simulations errors and way of resolution and community sharing



# Conclusions

- Pure virtual testing for certification will remain...virtual in the short to medium term
- Testing will still be needed
  - Model proof
  - Mitigation of simulation errors
- However, simulations will progress
  - Tool may be certified for certification credit
  - Alleviating more and more testing needs
- EASA should be ready for this Challenges
  - Aviation research coordination role



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**Questions?**

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