KEY ENABLING TECHNOLOGIES FOR VIRTUAL TESTING OF AIRCRAFT STRUCTURES - AIRBUS VISION

Abstract for '8th. World Congress on Computational Mechanics (WCCM8) and the 5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)Venice (Italy) - July 2008.

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Virtual Testing is usually described as the capability to provide by simulation blind prediction of the real-world structure physical behaviour. The prediction is expected to provide the structure strength value in order to ensure a proper sizing against in-service conditions.

It should also demonstrate the capability to describe in-depth local effects, material progressive damage up to localized material failure, and all the cascading effects up to final structure collapse. Moreover, it should provide a quantified level of uncertainty and confidence for the prediction: real-world tests are by nature prone to various sources of scatter, such as manufacturing and assembly tolerances, or load conditions. Finally, even if not scattered, a number of input parameters are unknown, this being turned into an uncertainty in the test scenario. This uncertainty should be taken into account in the prediction.

In the case of aircraft structures, a number of physical tests are performed to assess the structure performance when innovative design principles, materials, manufacturing processes or load conditions are to be implemented. The test specimen size varies from a few centimetres for material test up to several dozens of meters for full-scale test of aircraft fuselage and wing. The loading conditions are of various kinds, to be representative of in-service conditions, and include quasi-static loads up to failure, repeated load cycles, low or high energy impact. It includes also environmental effects, such as moisture or temperature. There is also a strong Certification context for the aircraft structures, and the means of compliance to this Regulation are done in accordance with the Airworthiness Authorities.

This paper deals with the AIRBUS vision on the key numerical technologies that need to be developed in the following years in order to provide a significant Virtual Testing capability for aircraft structures at industrial level. It highlights also the expected benefits, limitations and use of a Virtual Testing capability in the context of the aircraft certification process.

The following items will be covered:

- State of the Art in composite material damage behaviour law: industrial implementation for aircraft structures, current bottlenecks and way forward,
- Idealization rules in structure modelling: link between the efficiency of the CAD to CAE process and High-Performance Computing
- Use of high-performance computing for aircraft structure analysis: current status in AIRBUS and way forward,
- Scatter and uncertainty in Aircraft Structure modelling and simulation
- Test-Analysis correlation in the context of large-scale structures: current status, bottlenecks and way forward