11th. World Congress on Computational Mechanics (WCCM2014)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

STS 01: Airframe Flight Physics Key Green Technologies (KGT2) Synthesis and Proposal for future work.

A. Abbas, E. Valero

Dept. of Applied Mathematics
ETSIA
Universidad Polytechnic de Madrid (UPM), Madrid Spain
adel.abbas@upm.es, eusebio.valero@upm.es

Key words: Green Technologies, Reducing Emissions, Reducing CO2, Reducing Noise, Flight Physics and Large scale simulation;

Objectives:

In line with the overall objectives of GRAIN2 and on the basis of the achievements made in the previous GRAIN project, one of the main objectives for KGT2 is to make one step forward in the exploration of emerging drag reduction technologies for future aircraft, as well as of the tools and methodologies invoked to realize and implement the identified technologies for improved airframe designs. A second main purpose is to establish a collaborative platform and network including competent partners and, further to identify and select state-of-the-art technologies, tools and methods of mutual interest in Europe and in China for future collaboration of in-depth technical investigation.

Work will be organized in two steps. First, the most relevant technologies in the KGT fields and their level of development in both European and Chinese sides will be identified. This identification task will be supported by the contributions of all participants during the different dissemination actions and asynchronous meetings organized by the GRAIN2 network.

The second step will be the identification of the most promising technologies for future collaborative activities with European and Chinese participation. The objective here will be to be prepared for the generation of future collaborative projects for the joint development of new technologies in the context of the KGT areas.

Drag and CO2 reduction

Activities will be related to aircraft drag and weight reduction technologies and HPC numerical simulation technologies. This will include:

- Study of the state of the art of all corresponding technology in Europe and China.
- Identification and analysis of future and emerging technologies,
- Prospective of existing technologies that could be transferred from other fields which enable the reduction of drag to directly affect consumption (SFC) and related CO2 emissions control.

- Technologies evaluation on aircraft level identifying possible benefits.
- KGT2 will also study present and future IT technologies which facilitate and speed up the development of technologies for large scale simulation and optimization in aeronautics.

Proposal for Technology Themes

From previous experiences in projects such as GRAIN and others EU and national initiatives, one can identify and assess key aerodynamic technologies that offer the potential for the challenges of the Horizon 2020 to be met.

These technologies can be categorized into two different groups. *First*, technologies for viscous drag reduction (mainly skin friction) and the elimination of flow separation through the application of passive and active "flow control" strategies. *Second*, technologies aimed to reduce aircraft vortex (or induced) drag, targeting aircraft configuration optimization.

For the *first group* this can be summarized in:

1. Natural Laminar Flow control NLFC
2. Hybrid Laminar Flow Control HLFC
3. Turbulent boundary layer drag reduction

For the *second group*, the technologies to be considered are mainly targeting the geometries /configurations (either classical or innovative) optimization. This also may include optimization for active flow control devices application

Numerical Simulation and HPC

Numerical simulation is foreseen to provide a tremendous increase in aircraft design efficiency and quality over the next decade. Improvements in physical modeling of flight physics as well as aircraft structures and systems will be mapped to multidisciplinary models of the aircraft which could be executed in acceptable time on future HPC systems. The "Digital Aircraft" concept will enable engineers to drive the aircraft development process in a flexible and efficient way towards an overall optimized product.

Industrial numerical simulation tools, however, are still presently suffering two main drawbacks that prevent their full industrial deployment for massive applications. They are: not very ***efficient*** consuming excessively large computational time for problems of industrial relevance, and the ***reliability and accuracy*** of the solutions at flight extremes leading to separated unsteady flows.

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