Parametric-associative CAE methods in aircraft pre-design

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9) Funding source(s):
   - Industry

10) Partner organizations:
    - Airbus Deutschland, Kreetslag 10, 21129, Hamburg, Germany, www.airbus.com
    - Deutsches Zentrum für Luft- und Raumfahrt - DLR, 51147, Köln, Germany, http://www.dlr.de/

11) Short Summary: The aim of the project is to improve accuracy, efficiency and the flexibility
of current pre-design methods in the aircraft construction with the help of modern Computer Aided Design and Engineering (CAD/CAE) systems and methodologies.

12) Keywords: Aerospace Engineering

13) Project description:
Aircraft manufacturers are facing several challenges in the pre-design of complex and innovative aircrafts like the Airbus A380.

See Figure 1.

The aim of the project is to improve accuracy, efficiency and the flexibility of current pre-design methods in the aircraft construction with the help of modern Computer Aided Design and Engineering (CAD/CAE) systems and methodologies.

Conceptual design methodology
A conceptual design methodology will be developed in order to fully benefit from modern object-oriented CAD/CAE systems allowing to parameterize and associatively link assemblies, parts and sub-components.

The object-oriented architecture will be used for a smart data exchange between components in order to estimate important characteristics (e.g. weight) of complex assembly structures containing components with different levels of detail - at the early stage of the pre-design phase.

Fully parametric-associative models will allow modifying structures in a very flexible and efficient way. This will be an indispensable prerequisite for assessing a large variety of different design configurations using sensitivity analysis and FEM simulations.

Basic feasibility and advantages of parametric-associative models could be demonstrated with the example of a Airbus A340 flap track.

See Figure 2.

Knowledge management in aircraft design
The open architecture of today’s CAD systems will be used to integrate user-defined features and design rules, speeding up some repetitive design work and integrating some of the huge expertise represented by experts and senior engineers.

Multi-disciplinary aircraft optimization
The aerodynamic and structural design work of modern aircraft structures (e.g. high-lift wing of Airbus A380) represent a complex task, influenced from multi-disciplinary constraints, and cannot be considered independently.

With the advent of computational power and optimization tools, the ability to manipulate numerous aircraft design parameters in a reasonable amount of time is feasible. Within this project, parametric variational models will be used in order to perform multi-disciplinary optimizations with robust optimization tools, such as genetic algorithms.

The aim is to optimize aerodynamically relevant mechanical light-weight structures taking into account the coupling flow-structure interaction.

A modern CAD system will be used to perform structural optimization, feeding and controlling an external Computational Fluid Dynamics (CFD) tool, which will then feed back relevant aerody-
namical results in order to further modify and optimize parametric-associative aircraft structures.

See Figure 3.

Showing today’s possibilities, requirements and limitations of the highly parametric-associative approach for multi-disciplinary optimizations will represent one of the main outputs of this project and could be very beneficial for industrial applications and processes at the pre-design stage of aircraft construction.

14) Popular description: no entry

15) Graphics:

Figure 1: The Airbus A380 will be the largest civil transport aircraft

Figure 2: Parametric-associative flap track skeleton of an Airbus A340
Figure 3: Iso-pressure lines from a CFD flow analysis

16) Publications: no entry
17) Links to important web pages: