Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

DEPARTMENT FAHRZEUGTECHNIK UND FLUGZEUGBAU

Multi-Disciplinary Conceptual Aircraft Design using CEASIOM

Task for a Master thesis according to university regulations

Background

An aircraft conceptual design process can be segmented into two cycles (**Raymer 2006**): The initial layout and the revised layout. For the latter one, stability and control analysis, aerodynamics, weights, propulsion, structures, subsystems and costs become decisive. In order to be "first-time-right" e.g. with the flight control systems design already in an early stage of conceptual design level, an accurate and appropriate stability and control analysis becomes necessary.

The software package CEASIOM (Computerized Environment for Aircraft Synthesis and Integrated Optimization Methods), developed within the frame of SimSAC[1], aims at supporting the conceptual aircraft design process with emphasis on the improved prediction of stability and control properties. CEASIOM therefore features rapid low fidelity analysis as well as higher fidelity numerical simulations and integrates the main design disciplines *aerodynamics*, *structures* and *flight dynamics* into one application. It is therefore a tri-disciplinary analysis on the aero-servoelastic aircraft (**Von Kaenel 2008)**.

To run CAESIOM, the initial layout of the aircraft to be investigated has to be provided. CEASIOM then provides details of the baseline configuration by calculating performance, loads and stability and control parameters. The information obtained is sufficient to be input into a six degree of freedom flight simulator.

The baseline aircraft selected for this Master thesis is a 150 passenger, twin engine subsonic transport jet aircraft. A low and high fidelity tri-disciplinary analysis shall be conducted with the help of all available CEASIOM modules. Wherever possible, results shall be compared with values found in literature or in-house databases. The course of action in each module and

[1] SimSAC (Simulating Aircraft Stability And Control Characteristics for Use in Conceptual Design) Specific Targeted Research Project (STREP) approved for funding by the European Commission 6th Framework Programme on Research, Technological Development and Demonstration. Work began 1 November 2006 and lasted 3 years (see www.simsacdesign.eu). The SimSAC project aims at significantly enhancing CEASIOM functionality (**CFS Engineering 2010**)

the interrelation to others shall be explained and documented. The final result is thus a composition of data und experience obtained from each CAESIOM module with the baseline aircraft. If time permits, further analyses can be conducted with an adapted aircraft layout (e.g. high wing aircraft).

Task

- Literature research and familiarization with CEASIOM.
- Generation of the XML based file of the baseline aircraft (if applicable also of the adapted aircraft layout) with help of the Aircraft Builder Module (AcBuilder) for further processing in CEASIOM.
- Tri-disciplinary analysis of the baseline aircraft with help of
  - Aerodynamic Model Builder (AMB),
  - Next generation Conceptual Aero-Structural Sizing Suite (NeoCASS),
  - Simulation and Dynamic Stability Analyser (SDSA),
  - Flight Control System Design Toolkit (FCSDT).
- Verification of results obtained.
- Documentation of course of actions in each module and the interrelation to others.
- Discussion of results and CEASIOM practicability.

The report has to be written in English based on German or international standards on report writing.

Basic Literature

CFS Engineering 2010 CFS ENGINEERING: CEASIOM: Computerised Environment for Aircraft Synthesis and Integrated Optimisation Methods. Lausanne, Switzerland : CFS Engineering, 2010. – URL: www.CEASIOM.com (2010-05-21)

Raymer 2006 RAYMER, Daniel P.: *Aircraft Design: A Conceptual Approach*. Fourth Edition. New York : AIAA Education Series, 2006 – ISBN 1-56347-829-3

Von Kaenel 2008 VON KAENEL, R.; RIZZI, A.; OPPELSTRUP, J.; et al.: CEASIOM: Simulating Stability & Control with CFD/CSM in Aircraft Conceptual Design. In: *CD Proceedings : ICAS 2008 - 26th Congress of the International Council of the Aeronautical Sciences including the 8th AIAA Aviation Technoloy, Integration, and Operations (ATIO) Conference* (Anchorage, Alaska, USA, 14-19 September 2008). Edinburgh, UK : Optimage Ltd, 2008. - Paper: ICAS 2008-1.6.3 (061.pdf), ISBN: 0-9533991-9-2