Benchmarking New CEASIOM with CPACS Adoption for Aerodynamic Analysis and Flight Simulation

J. B. Vos*and A. Jungo†
CFS Engineering, EPFL Innovation Park, Batiment A, CH-1015 Lausanne, Switzerland
M. Zhang‡and A. Rizzi§
Airinnova AB, Stockholm, Sweden

1 Introduction & Background

Designing an aircraft is a very complex engineering task. The complexity needs to be handled by decomposition, as a hierarchy of different levels. In general the aircraft design process is divided into three phases: the conceptual design phase, the preliminary design phase, and the detailed design. The product fidelity, the model complexity as well as the designed time increase exponentially from the previous phase to the next one. A variety of *multidisciplinary design optimization* (MDO) methods have been developed that enable a formalized design optimization process in the preliminary design phase. In this paper we will focus on the early design stages, i.e., the conceptual design as well as the preliminary design, and find out way to improve the prediction fidelity in the early design.

1.1 Data-centric scheme CPACS and workflow manager RCE

Managing the interconnections from the multi-disciplinary design groups is complex and error-prone. Adoption of a standardized, data-centric scheme for storage of all data improves consistency and reduces risks of misconceptions and errors in the process. It requires an initial effort to make interfaces between analysis modules and the data archive. The CPACS (Common Parametric Aircraft Configuration Schema) [1, 2], developed by DLR, was adopted for the New CEASIOM framework, and is described in the following section. A design loop runs several analysis modules in sequence. The RCE integration environment and workflow manager records the sequence and manages the data transport and translation as well as logging the process. RCE, developed by DLR, makes it easy to set up and run a workflow also using modules in which the engineers are not discipline-experts.

1.2 CEASIOM history and New CEASIOM

CEASIOM (`www.ceasiom.com`) is a framework system that integrates discipline-specific tools like CAD, mesh generation, CFD, stability and control analysis, and structural analysis, all for the purpose of aircraft conceptual design [3]. The `New CEASIOM` is under development within EU Project AGILE (`www.agile-project.eu`), by adopting the CPACS XML data-format for representation of all design data pertaining to the aircraft under development. All the modules are available to be integrated via RCE with CPACS as I/O.

In this paper we will report the current status of the development for New CEASIOM, includes the following modules:

- CPACS file visualizer and editor *CPACSupdater* (Matlab) [4];
- Multi-fidelity CFD solvers: Tornado (VLM, Level 1) [5], Edge-Euler & SU2-Euler (Level 2), Edge-RANS & SU2-RANS (Level 3) [6, 7];
- Data fusion tool [3]: aerodynamic coefficients fusion from variable fidelity CFD tools above to compile complete aero-table for flight analysis and simulation;
- Automatic unstructured (Euler) & hybrid (RANS) mesh generation by *sumo* [8, 9];
- Stability and Control analysis module *SDSA* [10].

*Researcher, jan.vos@cfse.ch
†Research scientist, aidan.jungo@cfse.ch
‡Research scientist, PhD, Research Group, mengmeng.zhang@airinnova.se
§Scientific advisor, Professor Emeritus, Research Group, arthur.rizzi@airinnova.se