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Bringing Adaptive-Fidelity CFD to Aircraft Conceptual Design: CEASIOM

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Abstract. Present trends in aircraft design towards augmented-stability and expanded flight envelopes call for an accurate description of the non-linear flight-dynamic behaviour of the aircraft in order to properly design the Flight Control System (FCS). Hence the need to increase the knowledge about stability and control (S&C) as early as possible in the aircraft development process in order to be "First-Time-Right" with the FCS design architecture. In order to reduce the risks, cost and time of the conceptual design phase, the development of the Computerised Environment for Aircraft Synthesis and Integrated Optimisation Methods (CEASIOM) simulation system is currently in-progress. The overiding vision of CEASIOM is development of an interactive and integrated design environment where, for a given aircraft morphology, the coupled disciplinary analyses of aerodynamics, structures and flight dynamics can take place at some user-nominated fidelity during the conceptual design phase. A pedagogical example of analyzing the flying qualities of the 1902 Wright Glider and resizing its tail surface for better control illustrates the coupling of aerodynamics and flight dynamics in the design process of improving its flight control. Two MATLAB-based tools are used in the example: TORNADO, a Vortex-Lattice code for computing aerodynamic characteristics, and KiteSim, a flight-dynamic simulation tool to examine the flying qualities of the tethered 1902 Glider. The simulated results are found to be in good agreement with measurements in a windtunnel.

Key words: *Aircraft design, Aerodynamics, Flight dynamics, Flight control, CFD, Simulation.*

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