THE VIRTUAL PRODUCT
NEXT GENERATION SIMULATION FOR FUTURE AIRCRAFT DESIGN

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ABSTRACT

In recent years, the aeronautical industry has established numerical flow simulations as a key element in the aerodynamic design process, complementing wind tunnel and flight testing. Consequently, nowadays numerical simulation is already an important cornerstone for aircraft design. The continuous development of physical models and numerical methods and the availability of increasingly powerful computers suggest using numerical simulations to a much greater extent than in the past; radically changing the way aircraft will be designed in the future. In addition to speeding up and improving the product design cycle, numerical simulation provides the possibility to mathematically model all properties of the designed product with their interactions, and to determine the behavior under realistic operating conditions. The realization of the vision of an aircraft performing its maiden flight in a virtual computer environment, i.e. flying a virtual aircraft, offers the perspective for a substantial reduction of development risks, and in the medium and long term significant cuts in development costs through stepwise certification. Therefore, considering the future challenges for the aircraft industry, numerical simulation is considered as a key technology for future aircraft design [1], and development and industrialization of advanced simulation are being highly prioritized worldwide, see e.g. [2].

The key to master these challenges is the comprehensive exploration and exploitation of the technological possibilities offered by a consistent virtualization of all relevant processes regarding aircraft design, development, production and operation.

At DLR, the Virtual Product is one of the focus areas of scientific research in aeronautics. It generally addresses the digital description of an aircraft with all its properties and components based on highly accurate physical and mathematical models, and its operations. A realistic digital representation requires a description of the aircraft that is consistent across all disciplines and it must be possible to simulate every phase of the development process, from the design of aircraft and the prediction of its performance to detailed design and manufacturing.

The requirements for realizing the Virtual Product reach far beyond today's numerical simulation capabilities in aircraft development. The development of a high-fidelity simulation-based design and testing process, including virtual certification, is a multi-faceted problem and requires a comprehensive long-term, goal-oriented research strategy. Demanding challenges need to be mastered in the different flight-physics disciplines regarding the enhanced capabilities of simulation methods as well as their coupling. The presentation will outline DLR's approach towards addressing the challenges of next generation simulation methods and frameworks required to enable a stringent Virtual Product capability for aeronautics.

[1] *Flightpath 2050 – Europe's Vision for Aviation*, Report of the High Level Group on Aviation Research, http://ec.europa.eu/transport/modes/air/doc/flightpath2050.pdf, 2011.

[2] Slotnick, J., Khodadoust, A., Alonso, J., Darmofal, D., Gropp, W., Lurie, E., Mavriplis, D.: *CFD Vision 2030 Study: A Path to Revolutionary Computational Aerosciences, http://ntrs.nasa.gov/search.jsp?R=2014000309, 2014.*

[3] Kroll, N., et al.: *DLR project Digital-X: towards virtual aircraft design and flight testing based on high-fidelity methods*, CEAS Aeronautical Journal, DOI 10.1007/s13272-015-0179-7, 2015.