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A Validation Program for Dynamic High-Lift System Aerodynamics

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The feasibility of laminar flow control technology for future wing is bound to the development of a leading edge high-lift system that complies with the requirements on smooth surfaces to enable maintaining the laminar boundary layer flow, such as a Krueger flap [1][2]. Although in principle the aerodynamic performance of a Krueger flap is known, the unsteady behaviour of the flow during deployment and retraction is completely unknown. This is as even more important as during deployment the Krueger flap is exposed to highly unfavourable positions perpendicular to the flow. To mitigate the risk of unfavourable aircraft behaviour, it is therefore expected that a Krueger flap has to be deflected significantly fast and may trigger unsteady aerodynamic effects.

The European H2020 project UHURA[1], running from September 2018 to August 2022, has been focusing on the unsteady flow behaviour around such high-lift system and will first time deliver a deeper understanding of critical flow features at this type of high-lift device during their deployment and retraction together with a validated numerical procedure for its simulation. UHURA performed detailed experimental measurements in several wind tunnels to obtain a unique data set for validation purposes of Computational Fluid Dynamics (CFD) software, including detailed flow measurements by Particle Image Velocimetry (PIV) and other optical measurement technologies. Advanced CFD methods promising significant improvements in the design lead time have been applied and validated against this database to obtain efficient and reliable prediction methods for design.

Introducing this Special Technology Session, this first contribution provides an overview on the project. While the simulation activities are detailed in the forthcoming presentations, this presentation focusses on the experiments conducted to obtain a unique database for the validation of simulation methods for this kind of unsteady flows. Finally, an outlook is given on the validation and exploitation methodology applied in the last period of the project.

REFERENCES

[1] P.K.C. Rudolph, High-Lift Systems on Commercial Subsonic Airliners, NASA-CR-474, 1996.

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[2] H. Strüber, J. Wild, Aerodynamic Design of a High-Lift System Compatible with a Natural Laminar Flow Wing within the DeSiReH Project, 29th Congress of the International Council of the Aeronautical Sciences, ICAS 2014-0300, 2014.

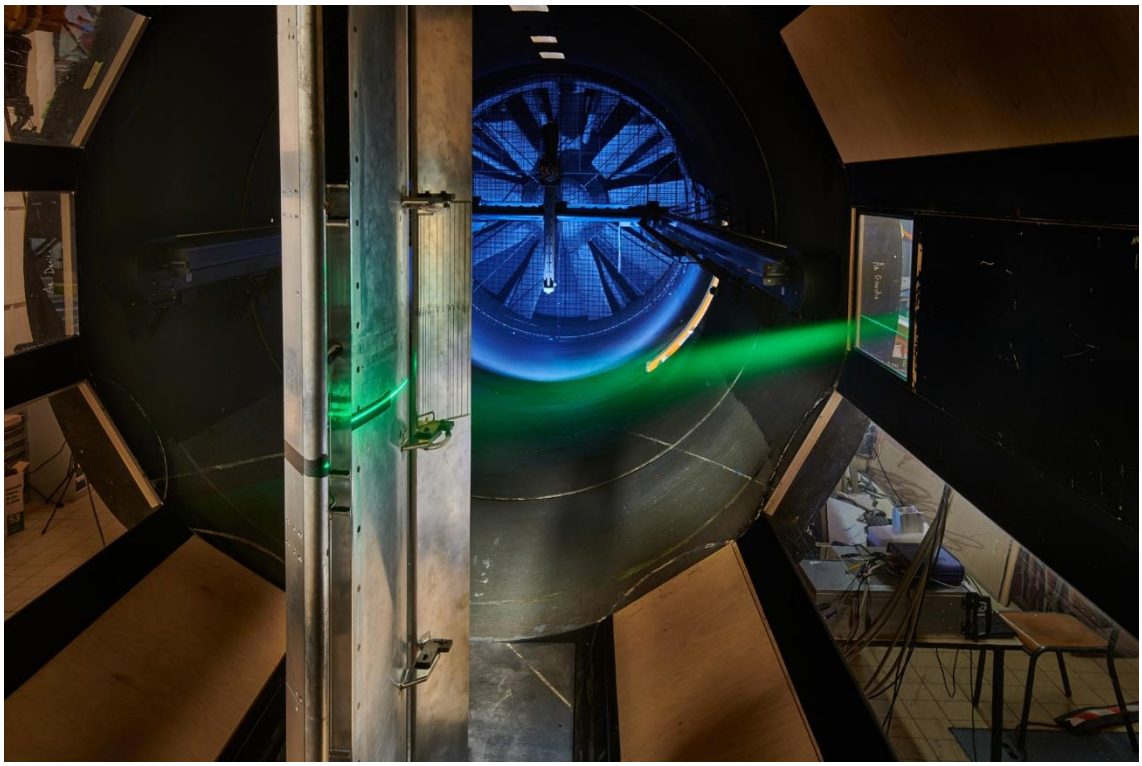

Figure 1: PIV image aquisiton of flow around deployed Krueger flap with the DLR-F15-LLE model mounted in the ONERA L1 wind tunnel, Lille, France (image: courtesy ONERA)