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Lattice Boltzmann simulation of a deploying Krueger device

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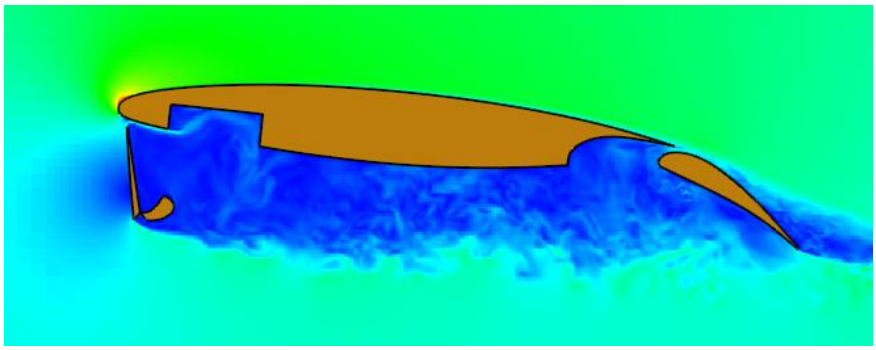
The H2020 UHURA project is dedicated to the simulation and experimental validation of the flow around a moving Krueger device that is designed to be operated in laminar wings. The unsteady flow present during the fast deployment and retraction of a Krueger device is quite complex, with massive turbulent flow separation in some phases of the motion, and strong dynamical effects are expected. Therefore, the unsteady CFD flow prediction is a big challenge requiring improved standard tools based on URANS solvers complemented by high-fidelity CFD tools based on scale-resolving simulation methods. Furthermore, detailed experimental data is required to validate the CFD predictions and to understand the flow physics produced by the motion of the Krueger.
In this paper, we describe the numerical simulations carried out within the UHURA project of the turbulent unsteady flow generated during the movement of the Krueger device using a commercial lattice Boltzmann solver based on a Wall-Modelled LES approach. The simulations are focused on reproducing one of the experimental test cases carried out in the ONERA-L1 wind tunnel during the UHURA project. The numerical method and the simulation setup are described. The simulation results are compared with the high-quality experimental data in order to assess the accuracy of the predictions. Comments are made about the computational efficiency and capability of the lattice Boltzmann solver for the prediction of the relevant features of the flow.



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