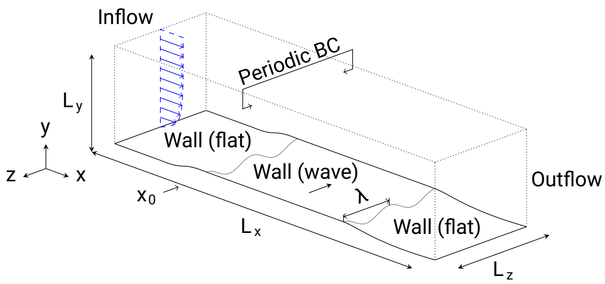
Working field abstract for potential Bachelor/Master theses

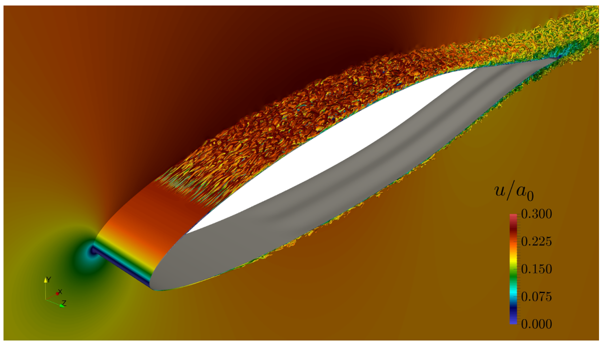
Active drag reduction in turbulent boundary layer flows subjected to spanwise traveling transversal surface waves using learning-enhanced CFD

Turbulent boundary layers over slender bodies generate a substantial drag force, which can make up a large share of the overall drag and CO_2 emissions of huge aircraft in cruise flight or high-speed trains. Spanwise traveling transversal surface waves is one particular active (external energy input) drag reduction technique being analyzed numerically. According to DNS-like (higly resolved) LES simulation the drag reduction and net power saving potential reached -31% resp. -10% at the maximum. The corresponding energy and CO_2 savings render this active drag reduction technique a theoretical option for meeting future environmental goals.

Due to a large space of actuation parameters and extensive computational costs for performing classical LES simulations at high Reynolds numbers, the identification of proper actuation settings for given flow conditions is challenging. In the context of the CoE RAISE project (`https://www.coe-raise.eu/boundary-layers`) physics-informed and compute-driven machine learning tools are explored to either reduce the overall computational costs, guide the determination of flow condition-dependent optimal actuation parameters or gain interpretable insights in how the drag reduction mechanism works on a basic research level before being realized and applied in practice.



Overview of the physical domain of the actuated turbulent boundary layer flow over a flat plate



Traveling surface waves on a DRA2303 airfoil reducing the friction drag and increasing the lift

You ...

- ... are interested in (computational) fluid dynamics, machine learning and surrogate modeling
- ... have fundamental programming experience (C++, Python) and a quick grasp for new concepts
- ... are eager to learn new skills and are able to work in an independent manner

If you are interested, please contact:

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