Turbulent boundary layer trailing edge noise reduction by employing a porous add-on
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While the wind turbines get bigger increasing the effectiveness of energy extraction, it is also accompanied by the increase of wind-turbine noise generation. This is negatively effecting nearby residents and wildlife.
The turbulent boundary layer trailing edge (TBL-TE) noise is the dominating noise source of modern wind turbines. Given that this noise type scales with the velocity to the power 5 this will only grow to be more important with increasing tubine rotor diameters, it would be efficient to mitigate this type of noise especially. This was done in a passive way in the past by using alternative geometries at the trailing edge of the blade such as serrations and metal foams. Another alternative passive noise reduction technique is the addition of a perforated add-on to the solid trailing edge. This promosing method is believed to outperform the current standard noise reduction techniques, a broad amount of experimental wind tunnel campaigns have been performed in the past, showing that the existing designed add-ons can reduce the TBL-TE noise up to 6dB. However, currently there is a lack of understanding of the physical working principle responsible for the perceived noise reduction.

This research project aims to advance the understanding of the physical flow mechanism responsible for noise mitigation in the far field for an airfoil with perforated trailing edge add-ons. Ultimately aiming to use this gained understanding in further improving the add-on design.
The methodology consists of performing high-fidelity numerical simulations with the commercial lattic Boltzmann solver PowerFLOW. This solver is known to be able to resolve complex geometrical features and is capable of capturing the propagation of acoustic waves through the domain , both required for capturing the flow features in the near-field of the perforations accurately as well as the acoustic generation.
In this research 3 different perforation configuration will be analysed aiming to identify the role of certain aeroacoustic mechanisms.