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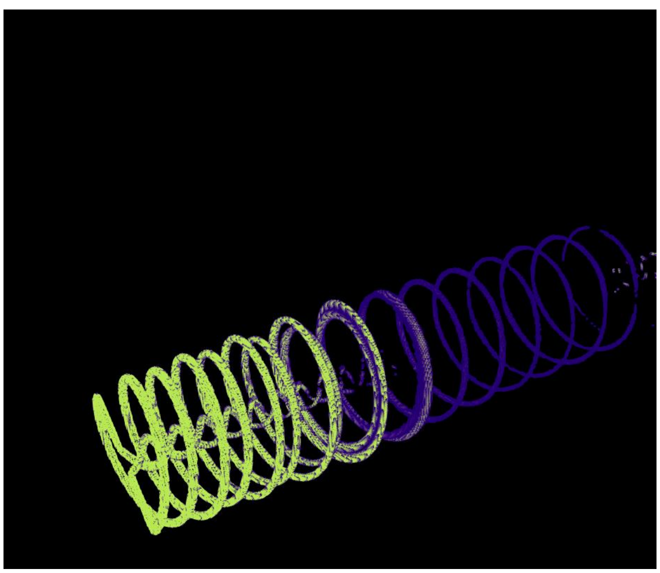
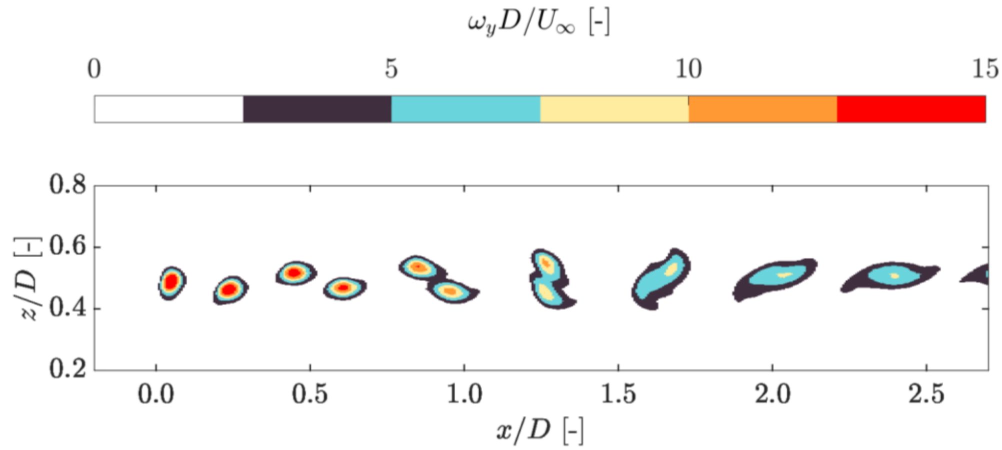
Topic of thesis: Numerical study of wind turbine wake control by tip vortex helix manipulation.

Abstract:

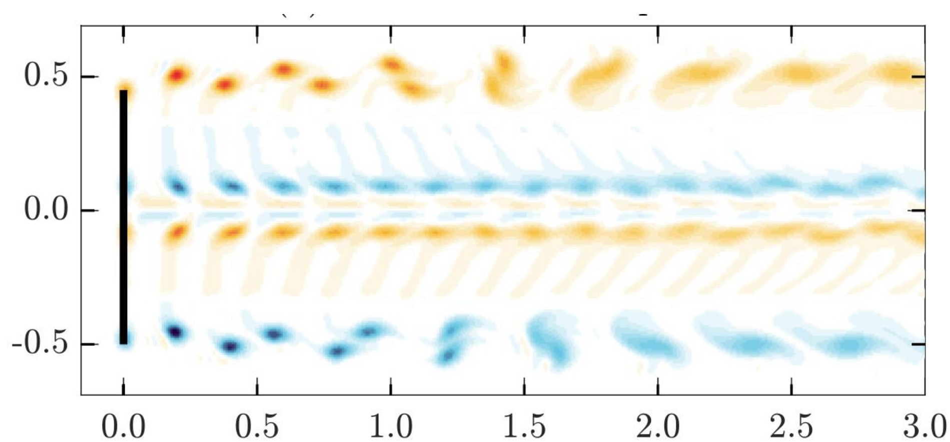
This thesis presents a numerical study on the control of wind turbine wakes through manipulation of tip vortex helices. The research focuses on the leapfrogging instability within the wake of horizontal axis wind turbines (HAWTs) and explores methods to intentionally trigger this phenomenon to enhance wake recovery. The study employs large eddy simulations (LES) combined with actuator line models (ALM) to investigate the behavior of tip vortices under various conditions, including rotor asymmetry and turbulent inflow. Key objectives include examining the effects of blade length differences on tip vortex behavior and assessing potential improvements in wake recovery efficiency. Findings indicate that manipulating the rotor configuration can significantly impact the stability and evolution of tip vortices.



Q criteria of the simulation of an asymmetric rotor



Tip vortex behavior: Leapfrogging phenomenon and merging process.



Vorticity field behind the asymmetric turbine