High-fidelity aeroelastic simulation of flexible wings in separated flows

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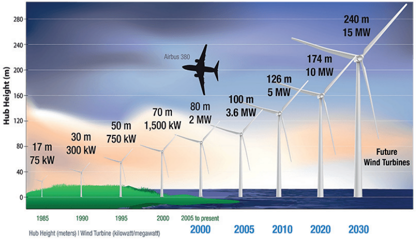
Coupled Problems 2021

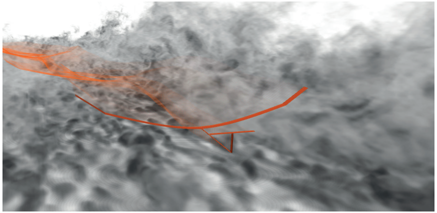
Objectives

Efficient high-fidelity Fluid-Structure interaction simulation method for

- Aeroelastic simulation of highly deformable slender structure
- High Reynolds-number flows
- Largely separated flows



Credit: NREL



SHARPy simulaiton of HALE wing
Credit: https://ic-sharpy.readthedocs.io/en/master/content/capabilities.html

Challenges

Separated flows

Finite thickness boundary layer
Leading/Trailing edges separation
Vortex shedding/interactions

Anisotropic turbulence

High-fidelity methods (LES/DNS)

High *Re* flow

Grid Resolution $h/L \propto Re^{-3/4}$
FLOPS scales as Re^3
Efficient numerical method
Highly scalable codes

Flow over NACA0012, $Re = 156\text{k}$, $\alpha = 16^\circ$
Q-siocontours colored by $|V|$

Slender structure and multiscale simulation