

# ***Computational and Experimental Aerodynamics***

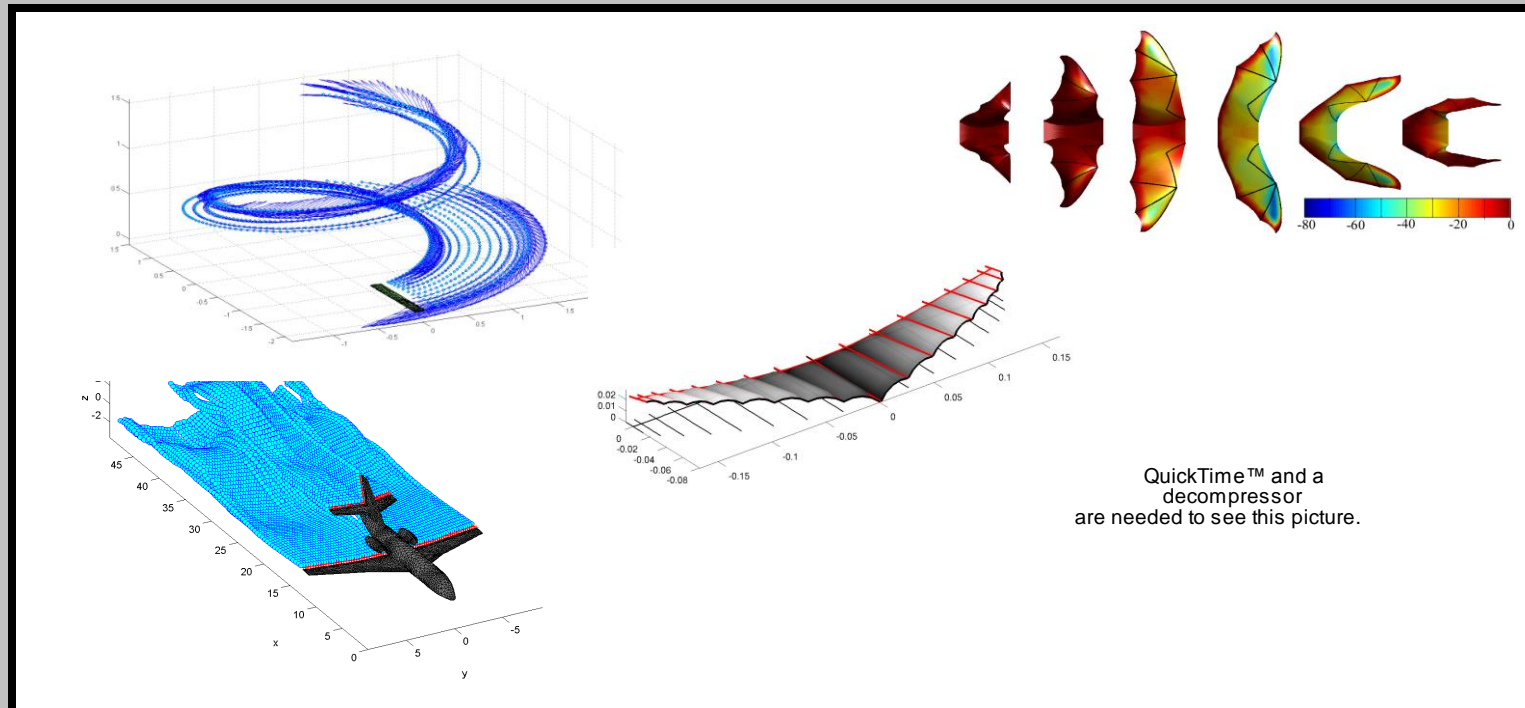
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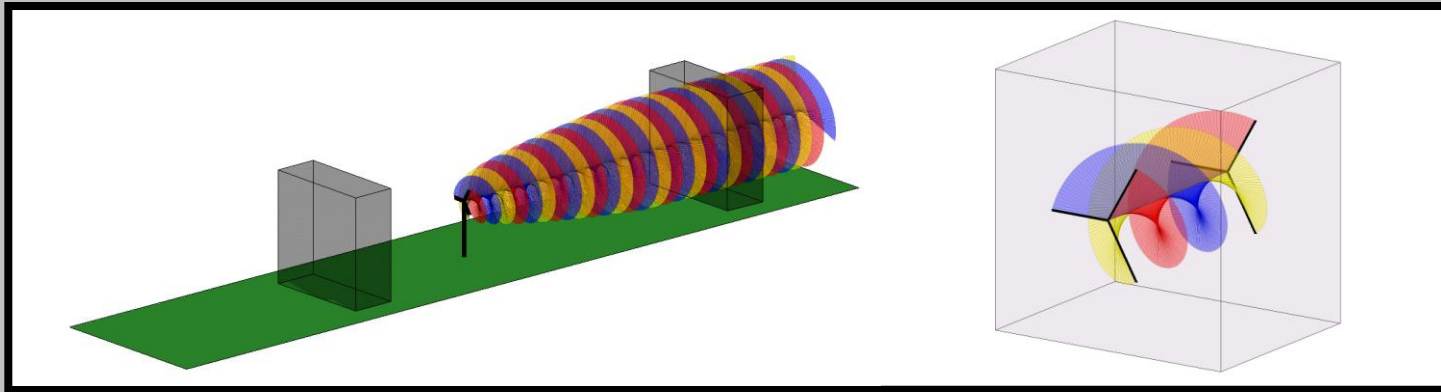
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# Background

- **Computational aerodynamics/structures**
  - Developer of scientific computing tools
  - Fast/efficient computations for unsteady aero
  - Aerodynamics Analysis/Research using computation/expt.



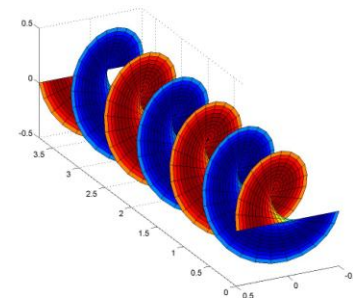
# Wake-only analysis for arbitrary wind turbines -- current effort



- ***Turbine wake is the “fluid footprint”***
  - Isolating the wake allows us to ignore turbine geometry
  - Lower fidelity, cost effective approach for v. early design work

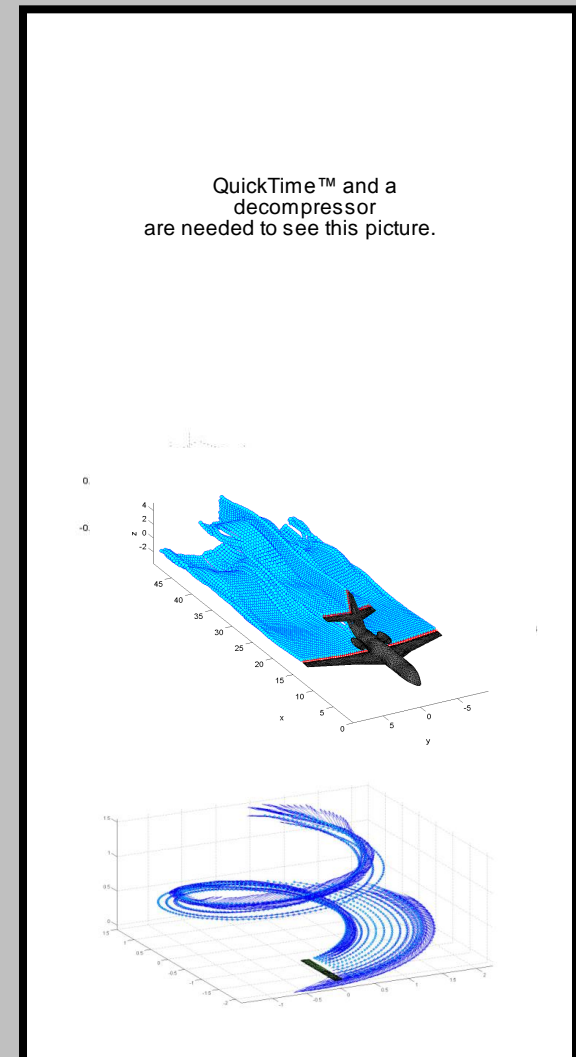
$$0 = \frac{\delta P_i}{\delta \Gamma} = \frac{\rho}{2T} \left( -2 \iint \vec{w} \cdot \hat{n} dA - \iint \vec{V}_\infty \cdot \hat{n} dA \right)$$

$$\iint_{S_w} \vec{w}(\Gamma) \cdot \hat{n} dA = -\frac{1}{2} \iint_{S_w} \vec{V}_\infty \cdot \hat{n} dA$$



# FastAero: Low to Moderate Fidelity Unsteady Aero Analysis

- **Potential Flow Solution**
  - Efficient unsteady solution of wing/blade motions
  - Requires surface meshes only
  - FastAero: Able to traverse fidelity levels
    - Lifting line/free-wake, V/DLM, BIEM
- **Implementation Details**
  - Linear basis unstructured panel method
  - Unsteady free vortex particle/sheet wakes
  - Fast --> Accelerated MVP calcs. (pFFT, FMM)
- **Current Efforts/Focus**
  - **Current Efforts:** IBLM coupling for unique WT design capability
  - **Current Efforts:** New automatic approaches for wake-wake and wake-tower intersection.



# Experimental Aerodynamics

- **Industrial aerodynamics laboratory wind tunnel**
  - 200 mph wind tunnel, Test Section : 3ft (w) x 2ft (H) x 4 ft (L)
  - Particle Image Velocimetry, 6-DOF force balance, 120 fps stereo-photogrammetry.
- **Computational/Experimental aerodynamics pre-proposal projects**
  - Investigating unsteady inflow and resulting unsteady wake evolution
  - Investigating boundary layer modeling and control in wind turbine aerodynamics

