Analysis of Aeroelastic Rotors Using Hybrid CFD Techniques

Nonlinear Computational Aeroelasticity Lab

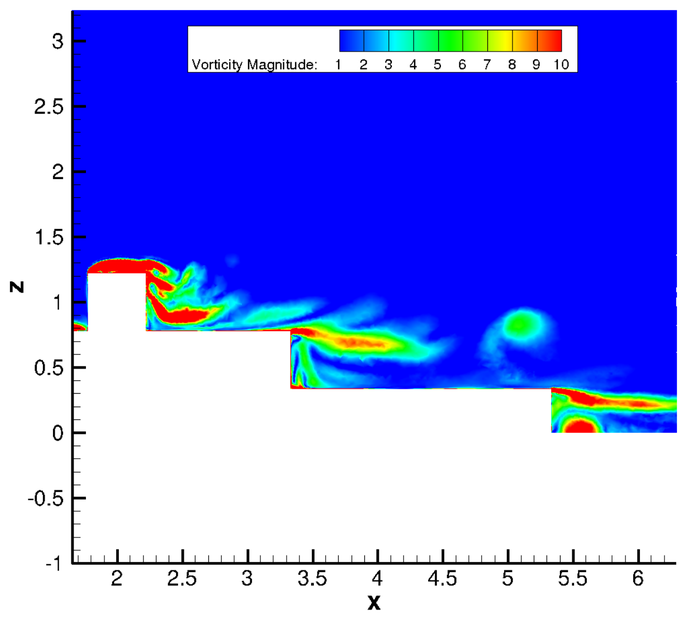
Why Use Hybrid Techniques?

- Using CFD/CSD for aeroelastic rotor analysis is computationally expensive
- Comprehensive Codes are not able to capture the nonlinear aerodynamics associated with many conditions
- Hybrid approaches can:
  - lower the computational cost by reducing or eliminating the CFD background grids
  - maintain solution integrity since nonlinear aerodynamics are captured

FUN3D/VorTran-M

•**FUN3D**: NASA's unstructured CFD software
•**Vortran-M**: CDI's inviscid, vorticity-conserving flow solver

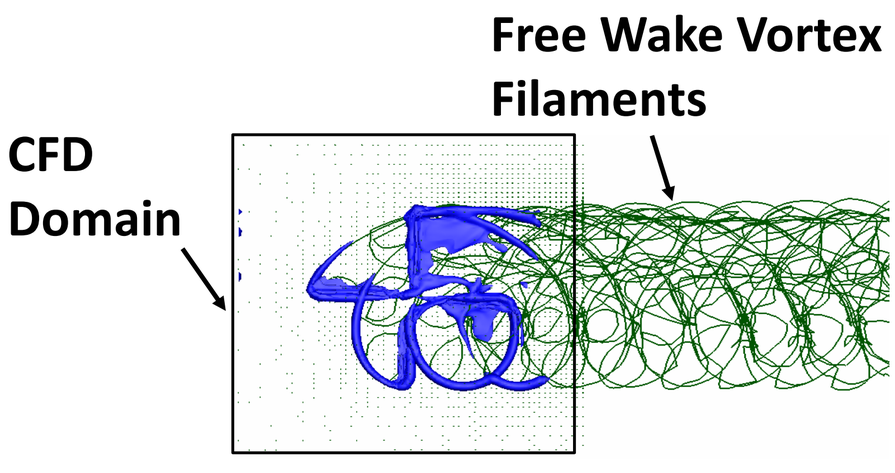
•Conventional Navier-Stokes solvers tend to dissipate vorticity over a short distance which impacts wake modeling
•Using Vortran-M in conjunction with FUN3D:
  • conserves vorticity which leads to more accurate results in all of the flow field
•smaller FUN3D grids which leads to reduce computational cost



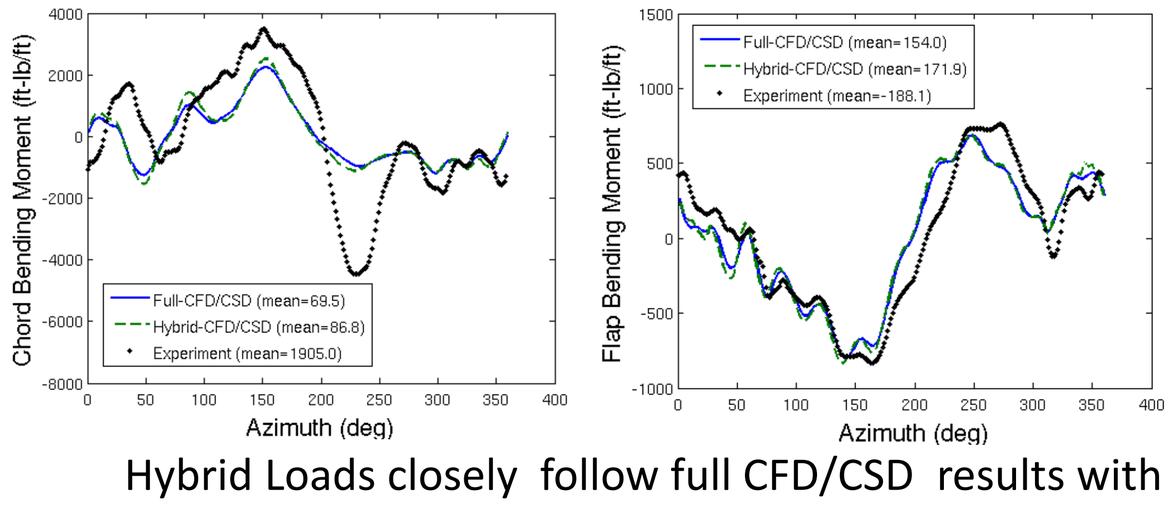
Hybrid simulation of a ship's air wake

OVERFLOW/Charm

•**OVERFLOW**: NASA's overset, structured CFD software
•**Charm**: CDI's free vortex wake code
•**OVERFLOW/Charm**:
- Model nearfield with CFD (OVERFLOW)
- Model farfield with free wake code (CHARM)
- Comprehensive code is used to update CFD boundaries
- CFD is used to update circulation for comprehensive code



Example of reduced CFD domain



Hybrid Loads closely follow full CFD/CSD results with approximately half the computational cost