Computational Aerodynamics of a Wing Mounted Propeller

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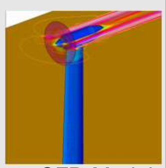
Introduction, Purpose, and Objective

- Propellers are used in many applications, one example being urban air mobility (UAM)
- It is important to be able to optimize propeller shape to increase aerodynamic efficiency
- Determine the normal, radial, and swirl velocities, find total pressure, thrust and torque distributions, then compare to optimized model.

About WIPP Validation Case

- 4-bladed actuator on wing tip
- Data taken every 0.2 inches
- Test conditions: M = 0.11, Ct = 0.4

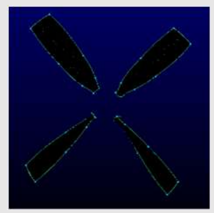


CFD Model

Flow Conditions	Value
Physical governing equation	Navier Stokes
Regime	Compressible
Mach number	0.11
Angle of attack (deg)	0
Temperature (K)	312.58
Viscosity (N s m^{-2})	1.9317E-5
Density (kg m^{-3})	1.338

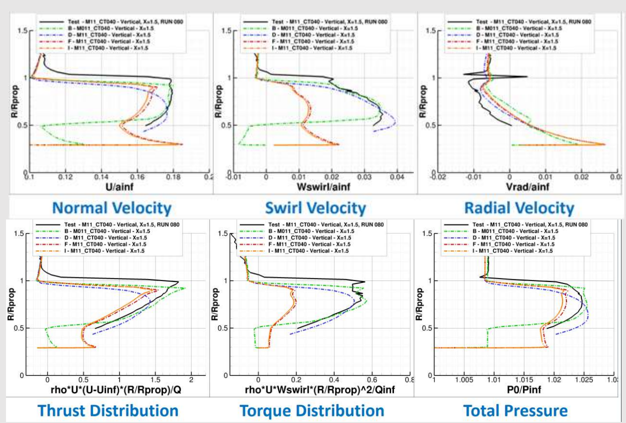
Method

- Validate computational results using SU2 v7.1 by comparing with WIPP experimental data
- Conduct analyses of both an isolated propeller (shown) and an installed wing case



Mesh of isolated propeller

- Create own study using similar flow conditions
- Conduct mesh independence study
- Optimize model using SU2
- Compare results to original WIPP case study:



Ongoing Work

- Determine if the current shape can be optimized
- Implications and significance:
  - Apply optimization to UAM
- Future work:
  - Would other airfoils improve performance?
  - How does this affect the generated noise as applied to UAM

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References

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