Effects of Inflow Velocity Profile and Rotational Accelerations on LEV Formation for a Revolving Wing

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Motivation

• Rotating wings create higher lift and greater force stability

• What are the individual contributions of rotational accelerations and inflow shear for a revolving wing in quiescent fluid?

\[ a_{cent} = \Omega \times (\Omega \times r) \quad a_{cor} = 2 \Omega \times u \]

http://www.zoo.cam.ac.uk/zoostaff/ellington/aerodynamics.html
Vorticity Visualization

Rotational Accelerations

No Rotational Accelerations

In-flow
Velocity
Gradient

Case A

Case B

Uniform
In-flow

Case C

Case D
Vorticity Visualization

In-flow
Velocity Gradient

Rotational Accelerations

No Rotational Accelerations

Uniform In-flow
Conclusions

• Inflow velocity gradient delays growth and shedding of the LEV primarily early in the wing rotation.

• Rotational accelerations maintain LEV attachment and stability later in the motion.