Wingtip Vortex Reduction

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What is Drag?

- Resistive force to forward motion
- Costs fuel
  - Fun Fact: a Boeing 747 consumes 1 gallon of fuel per second!
  - The fuel's main purpose is to counteract drag by supplying energy to the engines. Lift is the outcome.
- Subject of much research

Purpose

Reduce induced drag to save fuel and raise CL_{max}.

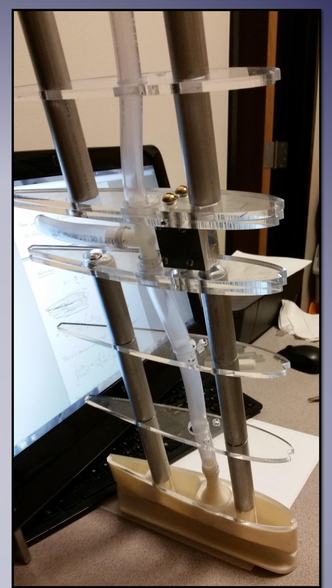
- Reduce energy wasted in the creation of vortices
- Increase lift
- Allows safer takeoff and landing into small airports.
- Increase fuel efficiency

Phenomena

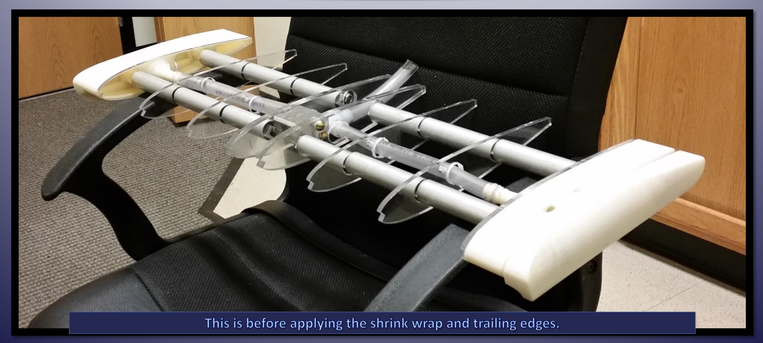
Some nice visualizations of wingtip vortices (wasted energy)

Experiment

- 3D printed wingtips
- Machined a slimmer wind tunnel mount to make room for tubing
- Constructed WingVac
- 170 wind tunnel tests on WingVac and identical standard wing
- Processed Lift and Drag data
- Compared to traditional wing



WingVac

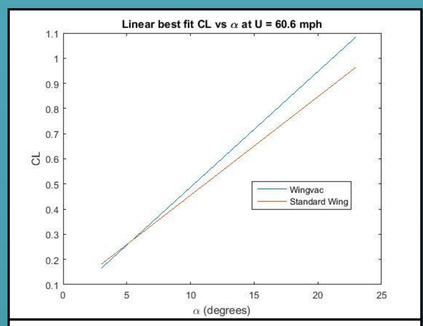


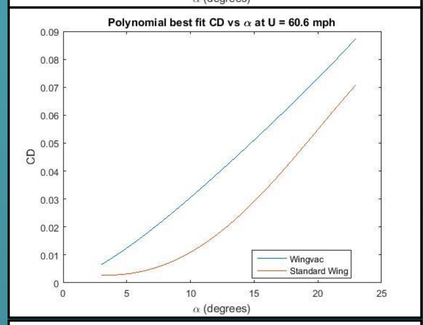
This is before applying the shrink wrap and trailing edges.

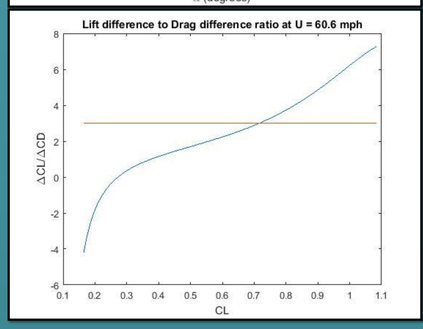
Background

- CL - Coefficient of Lift
  - How hard the wing is working
- CD – Coefficient of Drag
  - How hard the engines are working
- For this wing cruising CL would be around .3 to .4, takeoff and landing CL = .7 to 1.0
- α = angle of attack (angle between wing and airflow)

Wind Tunnel Results







Conclusion

- Works well at high CL, not so much for cruising CL
- Negative result because time frame is too short to save much fuel
- Suction helps flow stay attached at high angles of attack so CL_{max} went up
- Positive result because it increases pilot's margin for error on takeoff and landing
- May be a viable alternative for flaps, which are currently used to assist takeoff and landing

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