Co-Flow Jet Airfoil for Ultra-High Efficiency and Quiet Aircraft


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Airfoil: The fundamental element of aircraft

- Little new transonic airfoil improvement since 1960’s supercritical airfoil.
- Little new subsonic airfoil development since 1940’s NACA and European Airfoils.

Sir George Cayley Bt. (1773 - 1857)
Father of Aeronautics

mimicked from dolphin
Bird Wings: Super-Efficiency at Cruise

- Alaska Shorebirds, nonstop flight from Alaska to New Zealand in 9 days, 7145 miles, $V=14.8\text{m/s}=33\text{miles/h}$.
- Bird’s flapping wings generate lift and thrust due to the super-suction at leading edge at downstroke.

Super-suction at Leading Edge is the Key
Bird Wings: Super-High Lift Coefficient at Landing
• Owl’s Preying Maneuver, ultra-high AoA and Lift, no stall
• Quiet due to no wake turbulence noise

Super-suction at leading edge is the Key
Learn from Nature

• How can we generate supersuction with fixed wings?

• How can we use one set of wings for both high efficiency cruise and ultra-high lift at takeoff/landing?
Co-Flow Jet (CFJ) Airfoil: Ultra-High Efficiency

- High Lift, Low Drag, High Stall Margin,
- Low Noise, Low Energy Expenditure
- Zero-Net Mass Flux Flow Control
- Leading Edge Supersuction with Fixed Wing
Wind Tunnel Experiment of Co-Flow Jet Airfoil
University of Miami

M≤0.15
24”x24”x48”
Co-Flow Jet Airfoil Flow Control Experiment

- CFJ Airfoil has No Flow Separation,
- Reduce wake, generate thrust
- Very low energy expenditure
Ultra-High Lift, Low Drag, Low Energy Expenditure

Lift vs Angle of Attack

Wind Tunnel Test Results

Comparison of the tested lift coefficient for baseline NACA0025 and CFJ0025-065-196 airfoil

Unconventional drag polar, high lift with high thrust, low energy expenditure
Super-Lift Coefficient (greater than $CL_{\text{limit}}=2\pi (1+t/c)$)

$CL=10.6$, $C_{mu}=0.35$

$M=0.067$, Flow Attached at AoA=70deg. The circulation is so high that the stagnation point is detached from the airfoil.

Owl’s wing effect achieved by CFJ Airfoil at high AoA, high lift, no stall, no wake, no flap system.
CFJ Airfoil improves transonic cruise performance

M=0.73, L/D improved by 14.7%, CL improved by 18%, Productivity efficiency improved by 36%
Electric General Aviation Airplane Using CFJ, 4 Passenger, Range of 360 miles, 3X of SoA
“Engineless” aircraft propelled by CFJ Wing
Mars Aerial-Ground Global Explorer Using CFJ

Vertical takeoff/landing, Circle Mars 160 times

Mars Aerial-ground Nuclear GLobal Explorer (MANGLE)

One of the most important developments of 2014, AIAA, Aerospace America, 12/2014
Impact: CFJ airfoil revolutionizes aviation from the most fundamental element: the airfoil.

• Ultra-High Cruise Productivity Efficiency to Substantially Increase Range and Payload.
• Extremely Short Takeoff/Landing due to Super-Lift Coefficient
• Applicable from subsonic to transonic
• Flapless system to reduce noise, weight and cost
• Smaller size due to high wing loading (high CL)
• CFJ wing with thrust forms a new way of distributed electric propulsion, Ideal for hybrid-electric propulsion.
Product development: GA electric CFJ aircraft, 4 passengers, \( R=360 \text{ miles} \), \( V=220 \text{ miles/h} \), Double the range of the same size electric GA.
Product development: CFJ Transonic business Jet with hybrid (fuel + electric) propulsion, at least 30% more efficient than conventional aero design.
Ultra-High Efficiency Wind Turbine Using CFJ

Conventional Turbine

CFJ Turbine, 30% more power
Leadership Team

Gecheng Zha, PHD,
President,
Professor on Aerodynamics, CFD, Aircraft Design, Inventor of CFJ Airfoil Technology

Joseph Johnson, PHD,
VP of Marketing, Associate Professor on New Product Development, Strategic Brand Management, Marketing Strategy

Peter Trogos,
VP of Business Development, Former Academic Ambassador of Dassault Systèmes, Industry Advisor at ASME, BS of Mathematics
Engineering Team Leaders:
Dr. Yan Ren, Mr. Yunchao Yang (Ph.D. Candidate)

Annual BBQ in Dr. Zha’s house
Mission: Transform Aviation Industry with Ultra-High Efficiency Coflow Jet Wing from Subsonic to Transonic Speed.

Objective: Commercialize CFJ Technology to Benefit Society.

Collaboration and Investment welcomed.

Together, We change the world.

Coflowjet.com

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