TICKLE COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL, AEROSPACE & BIOMEDICAL ENGINEERING

volAIR

revolutionary
Aerodynamics
Innovation and
Research

NASA University Leadership Initiative: Ultra-Efficient Commercial Vehicles

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About Me

Jim Coder

Assistant Professor, University of Tennessee

Research Areas: Computational aerodynamics, laminar-turbulent transition modeling

- PI for Ultra-Efficient Commercial Vehicles project (ARMD Thrust 3A)
- Senior Member of AIAA and member of Applied Aerodynamics Technical Committee

Our Work: Ultra-Efficient Commercial Aircraft

Challenge: Pioneer technologies for leaps in U.S. aircraft efficiency and environmental performance

- ***Less fuel/energy consumption***

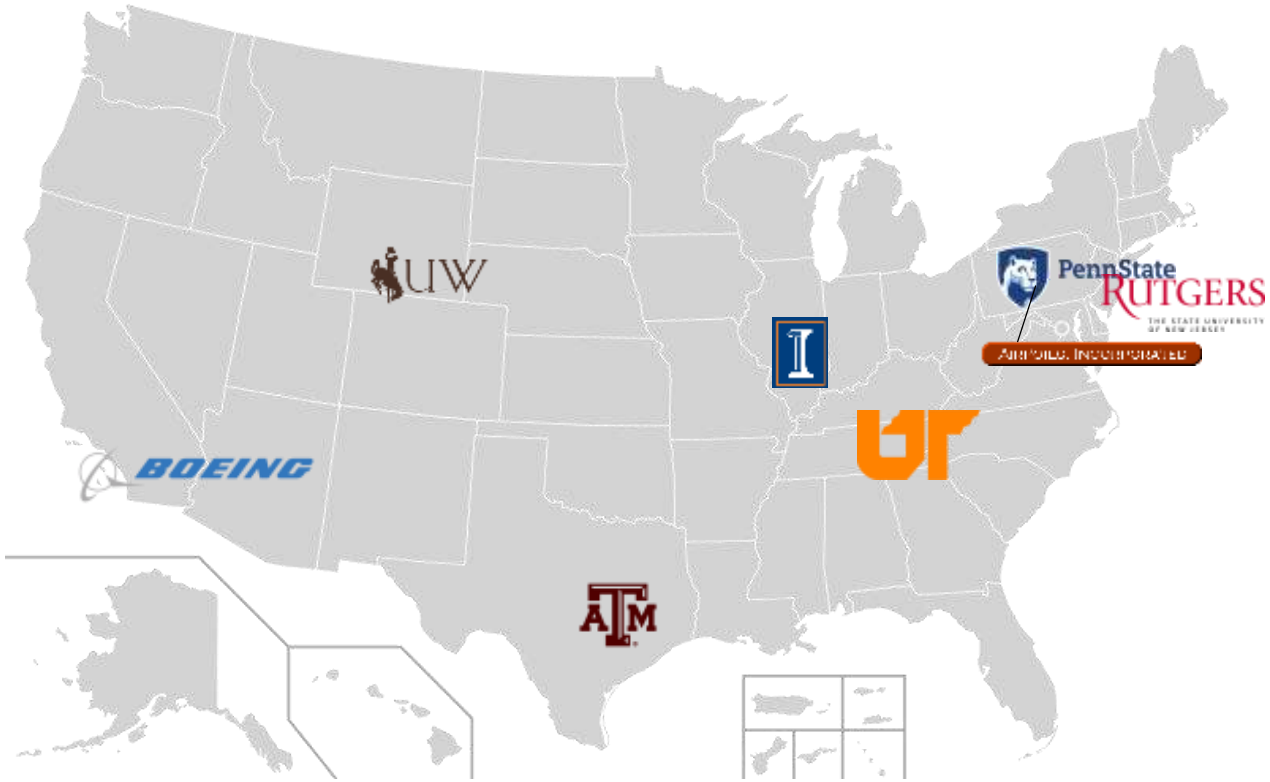
Solution: Revolutionary wing aerodynamics applied to advanced aircraft design concepts

Predicted Benefits:

- Economic competitiveness
- Lower fuel costs per flight

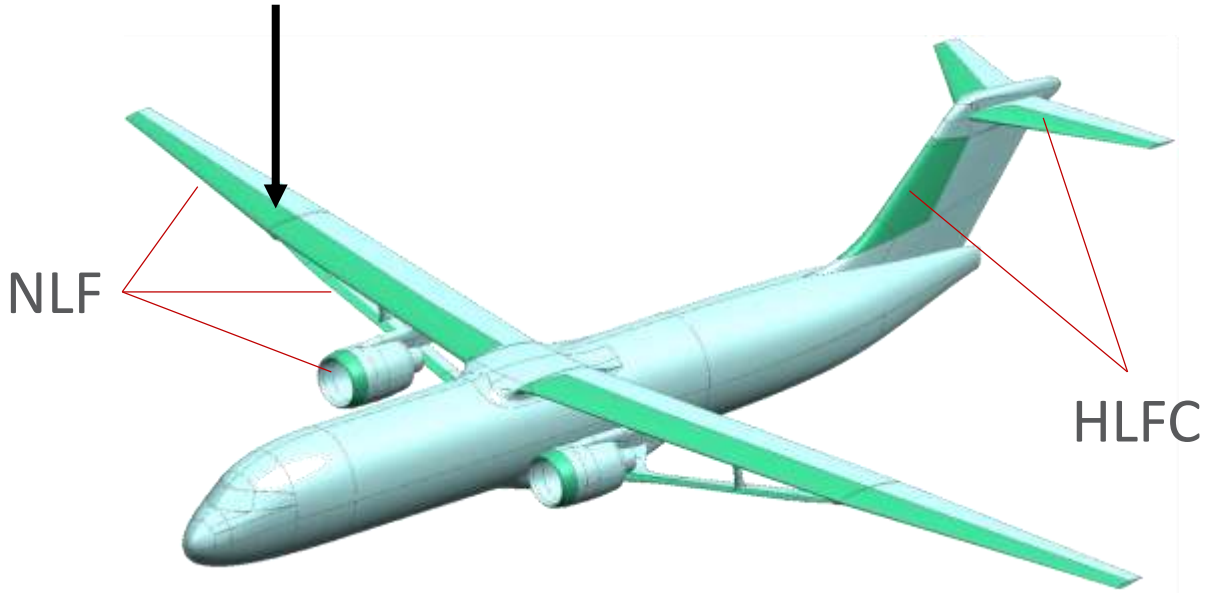
Our Team: Value-Added Expertise

- Multidisciplinary, geographically diverse team covering all areas of aeronautics
- Five academic partners
- Two industrial partners
  - Airfoils, Incorporated
    Boeing Research & Technology in Huntington Beach, CA



Core Technology: Slotted, NLF Airfoils

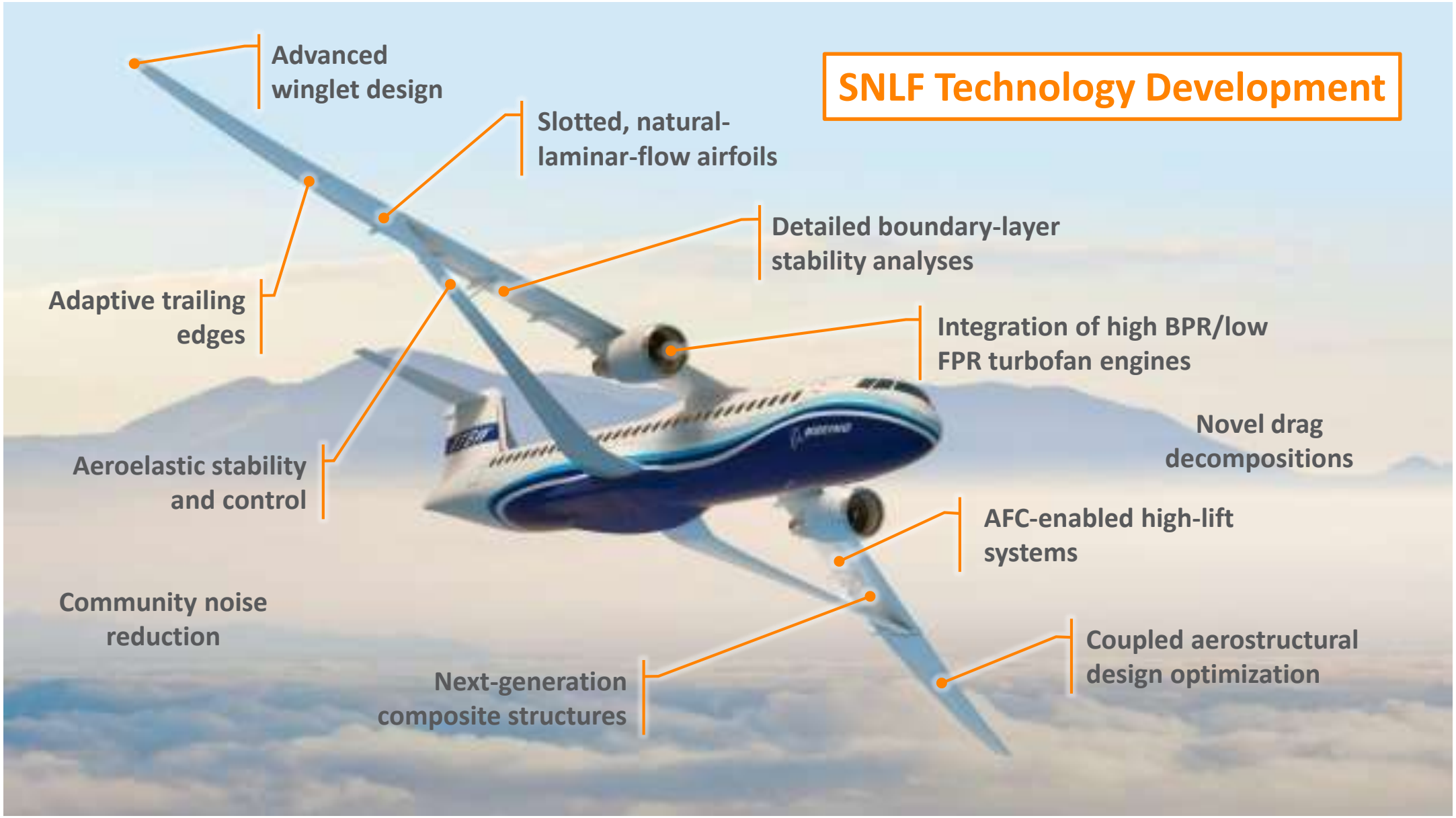
S207, Slotted, Natural-Laminar-Flow Airfoil



Boeing Transonic Truss-Braced Wing (M=0.745)

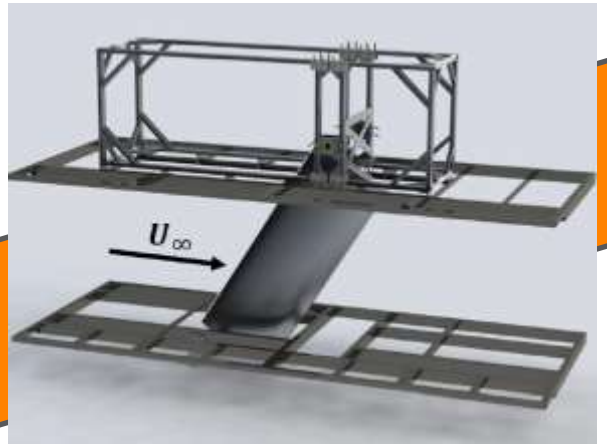
- Simultaneous decrease in cruise drag and increase in maximum lift coefficients
- Off-surface pressure recovery offers benefits for transonic wave drag
- **Changes the rules for wing design**

Vehicle-level performance analyses by Boeing show 59% decrease in block fuel per seat compared to 2008 Baseline due to SNLF technology


SNLF Technology Development
Advanced winglet design
Slotted, natural-laminar-flow airfoils
Detailed boundary-layer stability analyses
Adaptive trailing edges
Integration of high BPR/low FPR turbofan engines
Novel drag decompositions
Aeroelastic stability and control
AFC-enabled high-lift systems
Community noise reduction
Coupled aerostructural design optimization
Next-generation composite structures

Experimental Validation of Concept

Preliminary Proof of Concept



Risk-Reduction Experiments (2019/2020)

Capstone Technology Demonstration (2022)

Our Vision: Impacting Aircraft *and* Students

Educational Impact

Covering the workforce development pipeline from elementary through graduate school

- Most research activities led by funded graduate students
  - 6 MS, 12 PhD students in 2018-19
- Undergraduate student research opportunities and experiential learning
  - 11 UG, including summer students in 2019
- Annual Boeing summer internship for *at least* one student from partner schools

Educational Outreach

Summer Undergraduate Research Experience

Summer Internships at Boeing

REVOLUTIONARY AERODYNAMICS