

NASA Advanced Subsonic Transport Aircraft Concepts

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Advanced Air Transport Technology (AATT) Project

WV NASA IV&V 'Virtual Day in the Park'
October 14, 2021

Agenda

- Who am I?
- Some aircraft basics
- How can we revolutionize aircraft?
- NASA Transonic Truss-Braced Wing (TTBW) Concept
- NASA N3-X Hybrid Wing Body (HWB) Concept
- Interested in further reading?

Who am I?

A little about me…

https://www.nasa.gov/aeroresearch/programs/aavp/aatt



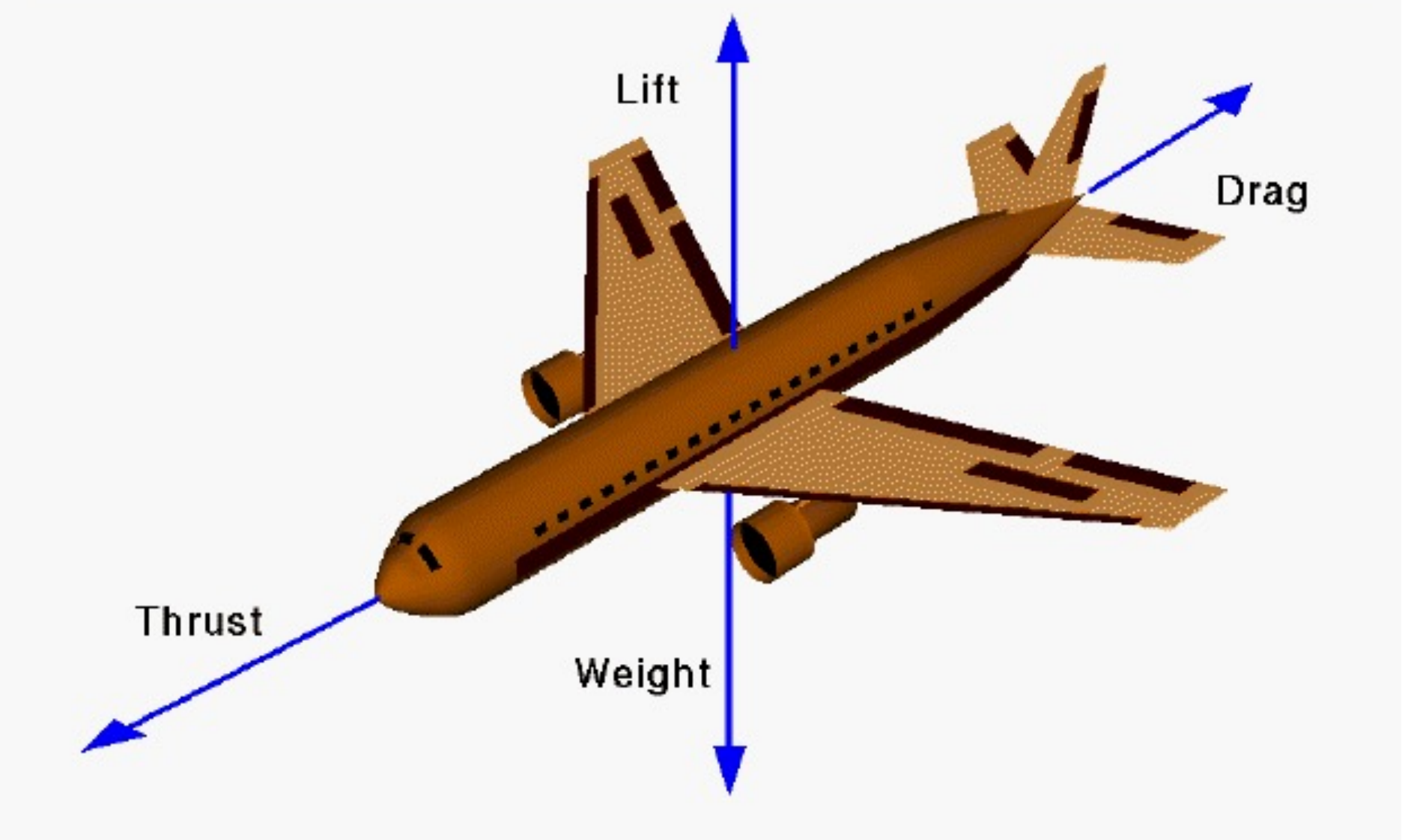
https://sacd.larc.nasa.gov/asab/



https://engineering.virginia.edu/faculty/jesse-quinlan

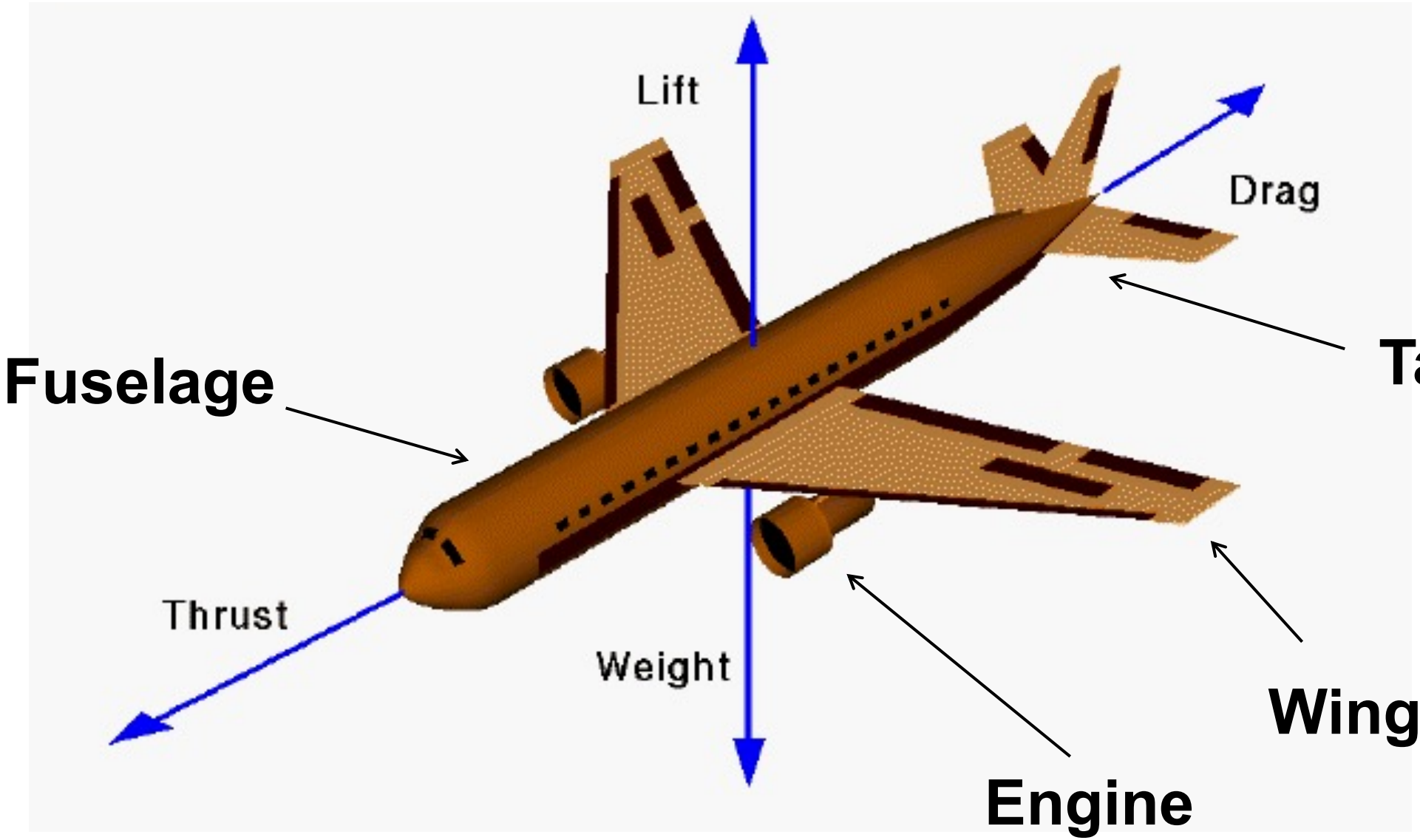
Some Aircraft Basics

Basics of an Aircraft: Configuration



https://www.grc.nasa.gov/www/k-12/airplane/airplane.html

Basics of an Aircraft: Configuration



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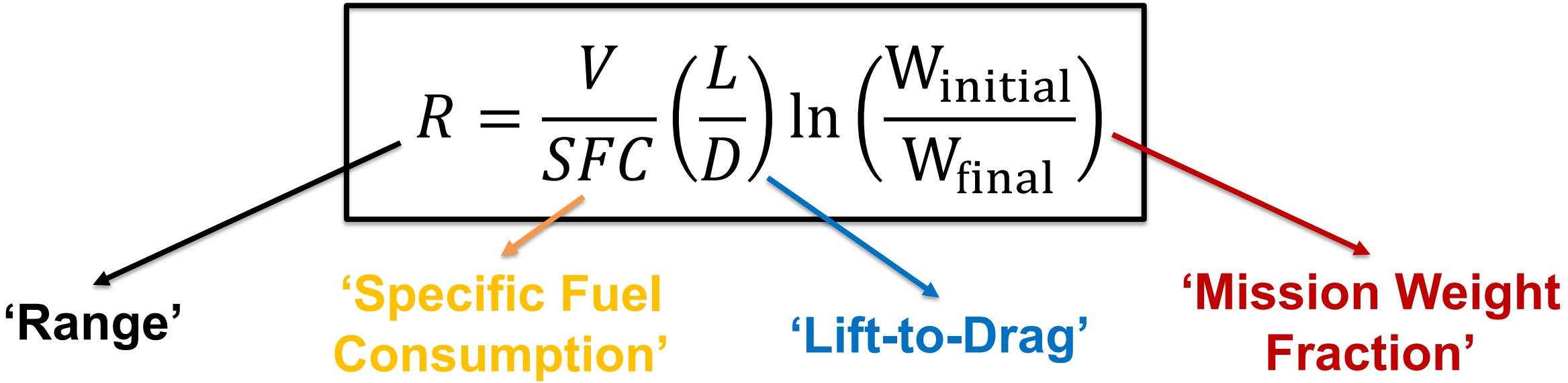
Basics of an Aircraft: Performance

”The Breguet Range Equation”

$$R = \frac{V}{SFC}\left(\frac{L}{D}\right)\ln\left(\frac{\mathrm{W}_{\mathrm{initial}}}{\mathrm{W}_{\mathrm{final}}}\right)$$

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‘Range’

‘Specific Fuel Consumption’

‘Lift-to-Drag’

‘Mission Weight Fraction’

How far an airplane can fly

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How far an airplane can fly

How efficiently an airplane turns fuel into thrust

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How efficiently an airplane turns fuel into thrust

‘Lift-to-Drag’

How efficiently an airplane generates lift

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How efficiently an airplane turns fuel into thrust

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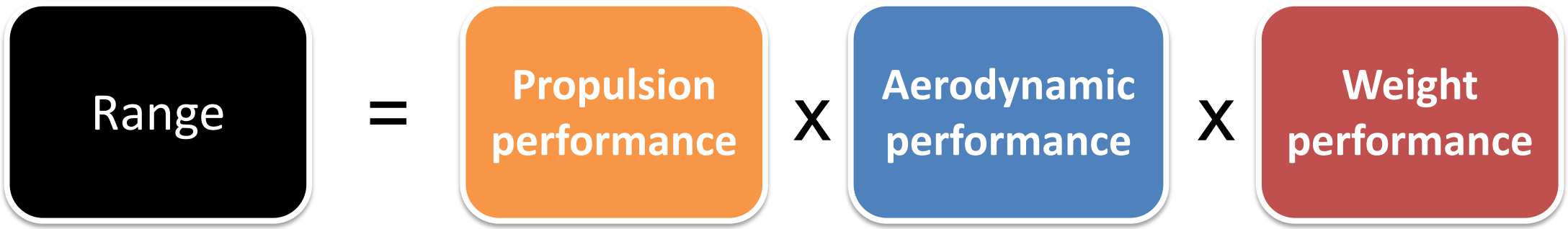
How efficiently an airplane generates lift

‘Mission Weight Fraction’

The takeoff weight divided by the landing weight

Basics of an Aircraft: Performance

”The Breguet Range Equation”



Basics of an Aircraft: The Aviation System



How can we revolutionize today's aircraft?

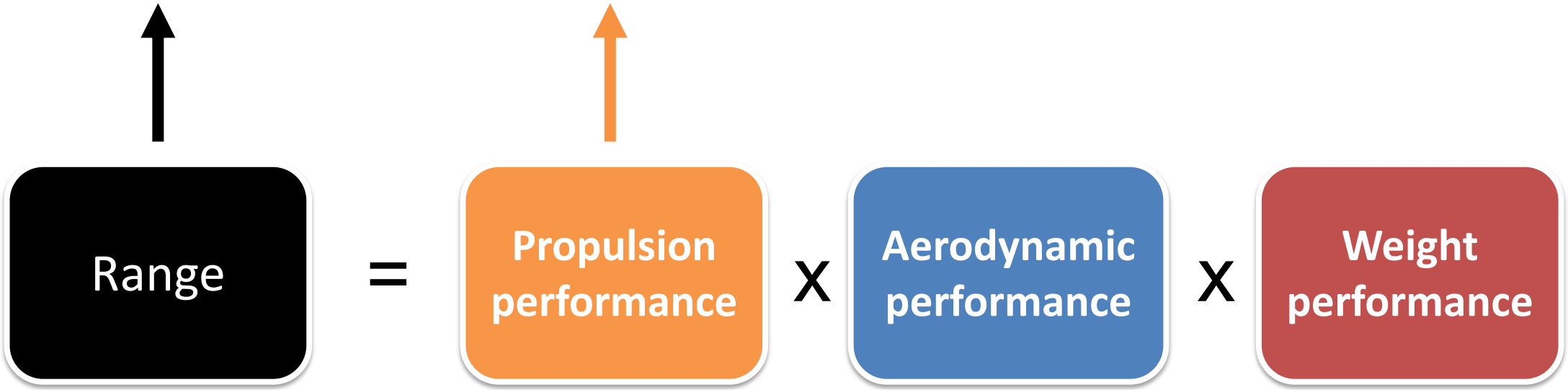
How can we revolutionize aircraft?

Back to the basics!

Range = Propulsion performance x Aerodynamic performance x Weight performance

How can we revolutionize aircraft?

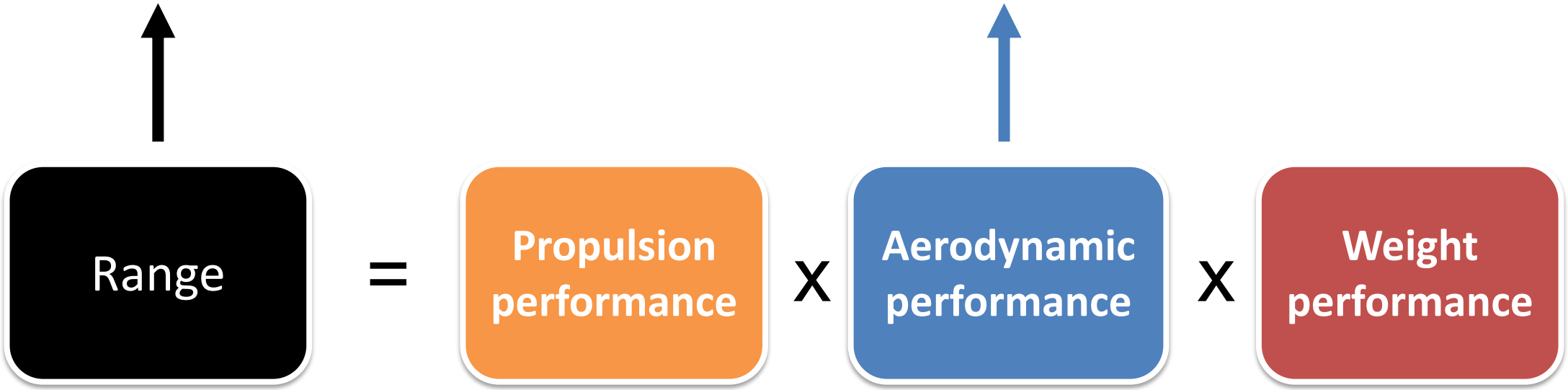
Back to the basics!



Improve Propulsion Performance
(Decrease Specific Fuel Consumption)

How can we revolutionize aircraft?

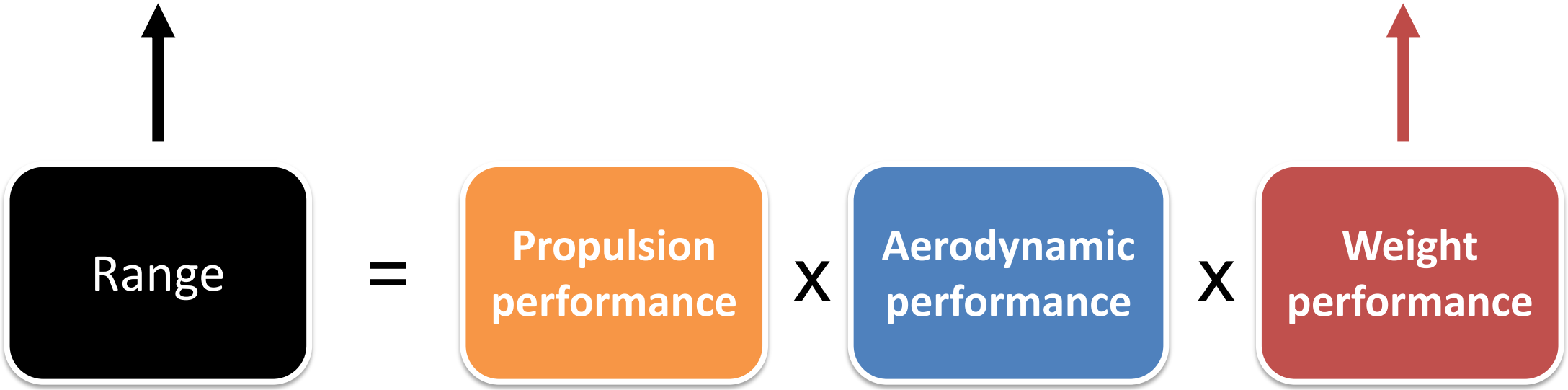
Back to the basics!



Improve Aerodynamic Performance (Increase Lift-to-Drag Ratio)

How can we revolutionize aircraft?

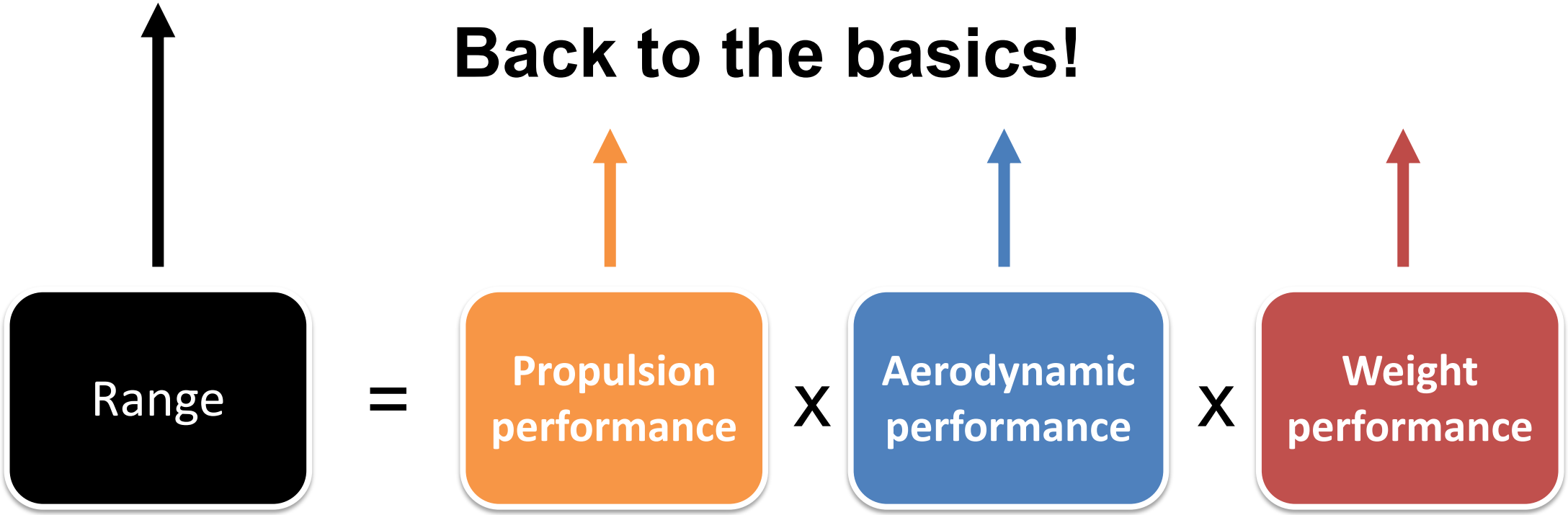
Back to the basics!



Improve Weight Performance
(Decrease Weight of the Aircraft)

How can we revolutionize aircraft?

Back to the basics!



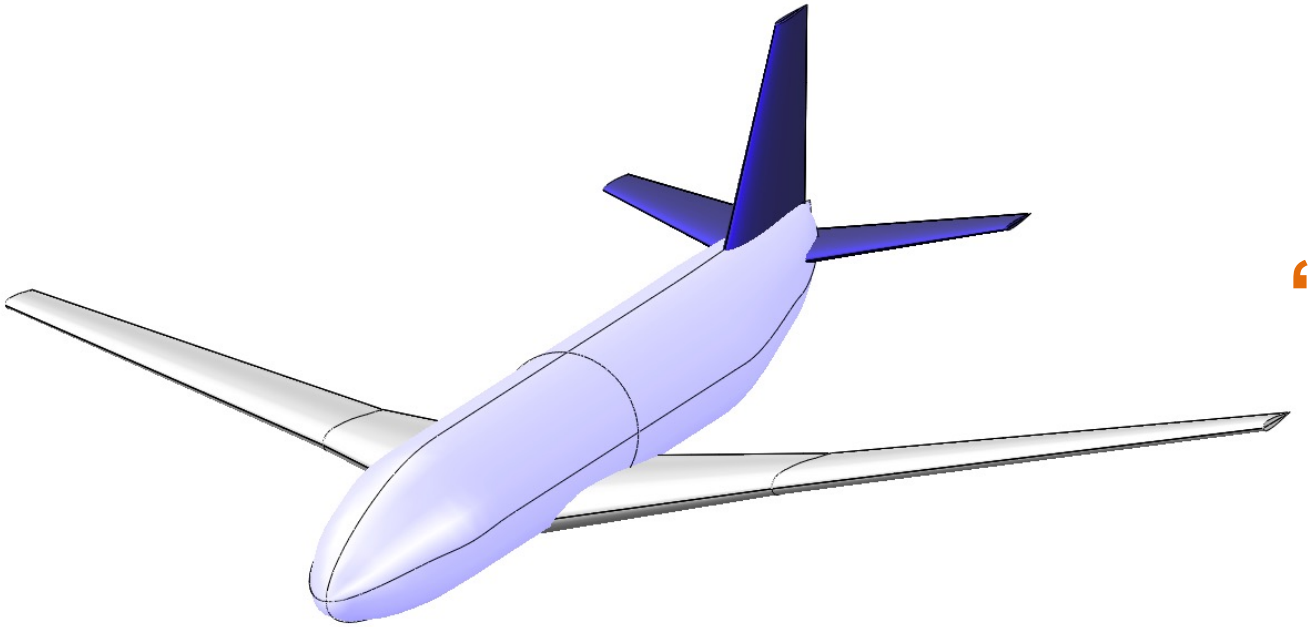
Even better – do them all at the same time!

How can we revolutionize aircraft?

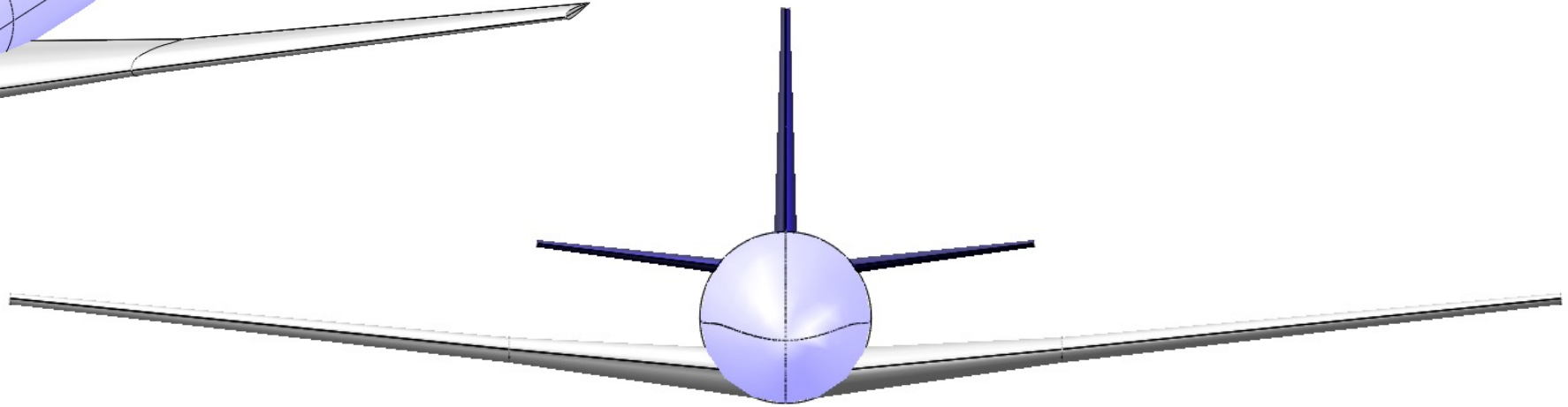
Let’s talk about wings.

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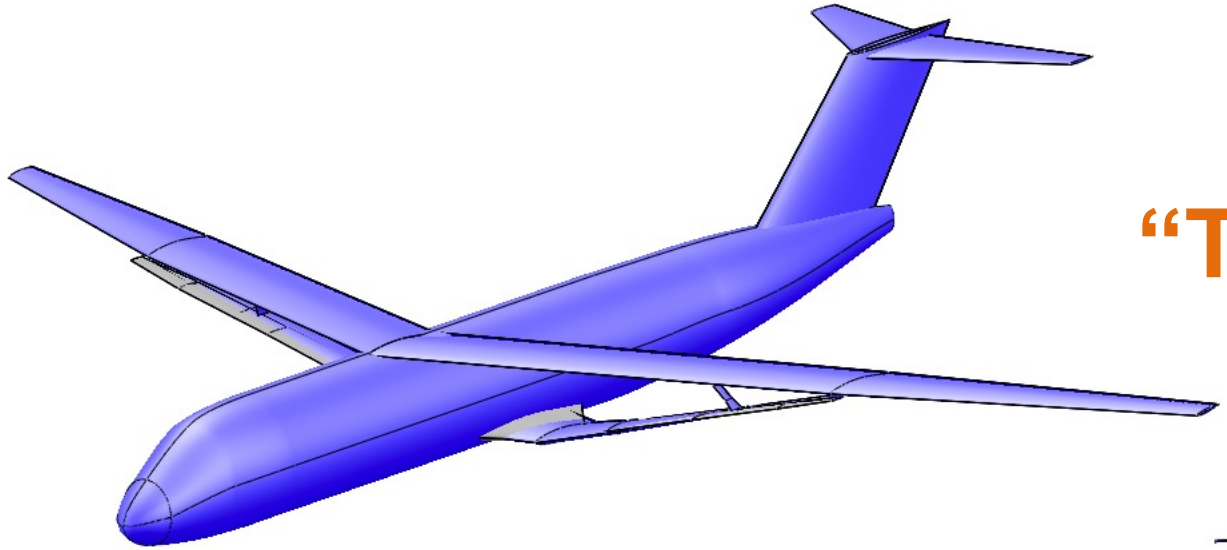


"Cantilevered Wing"

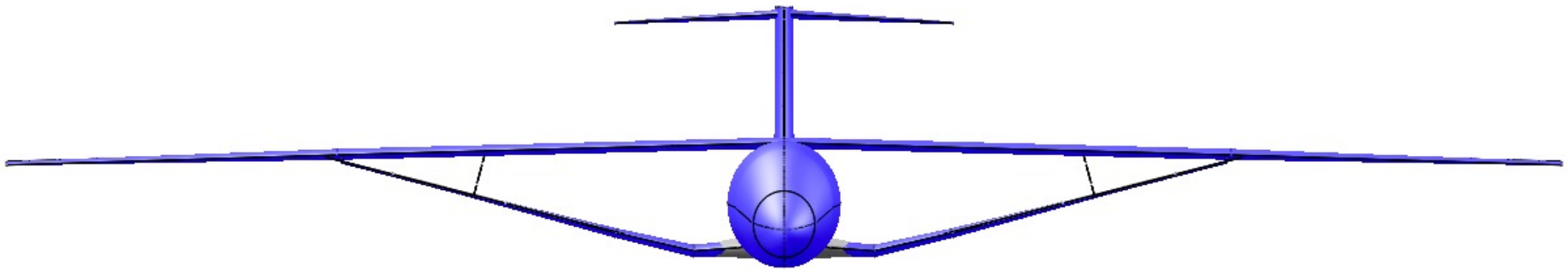


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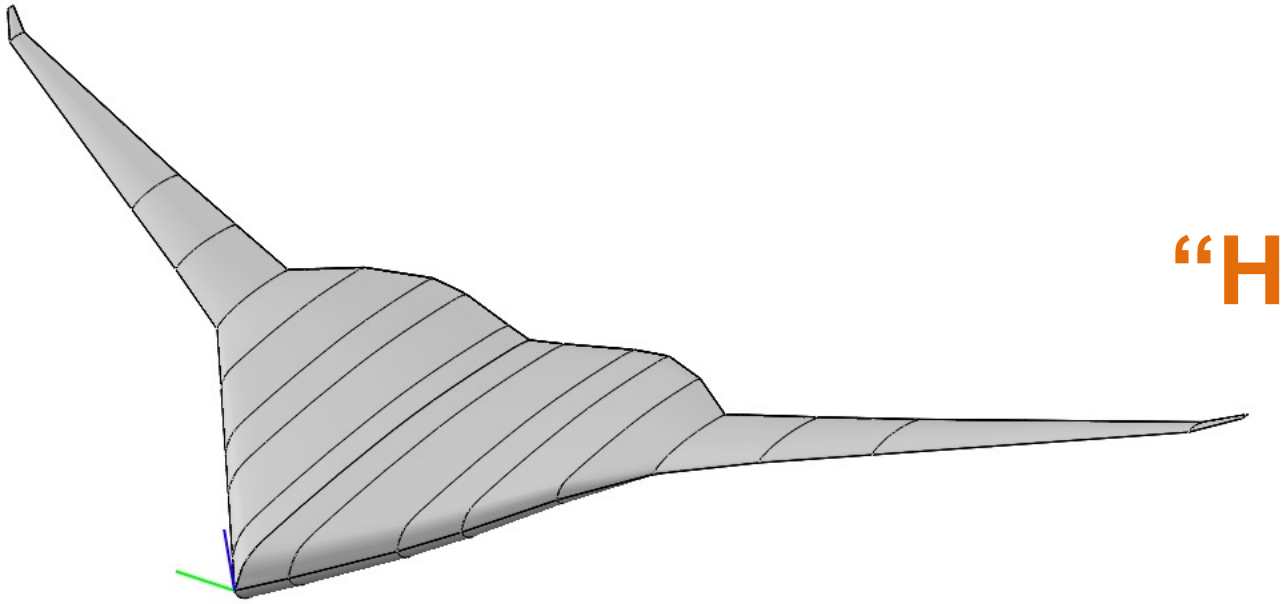


"Truss-Braced Wing"

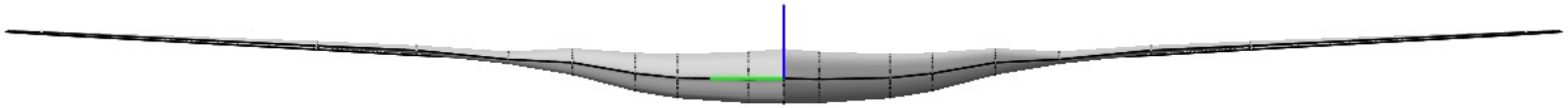


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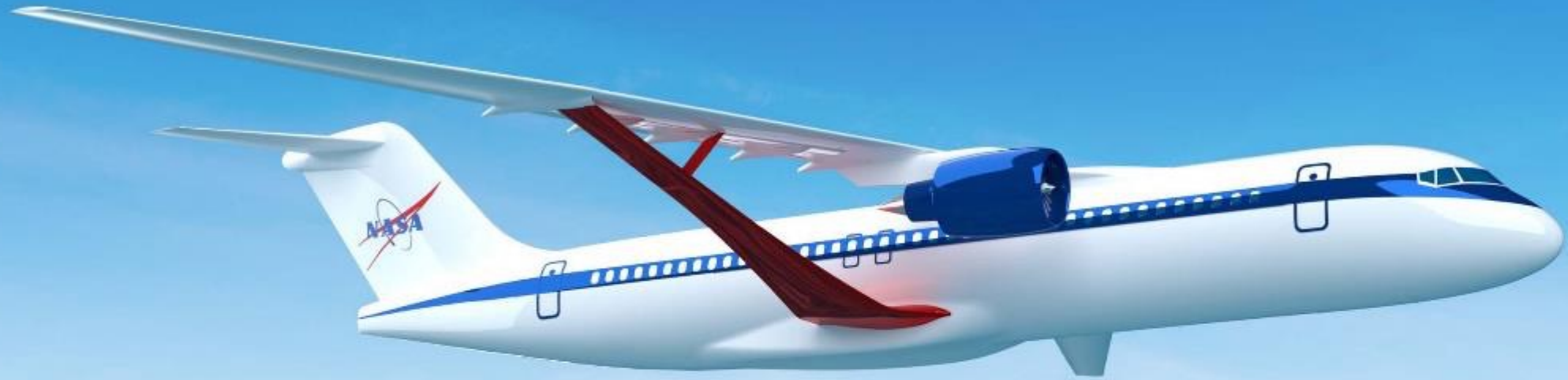


"Hybrid Wing Body"



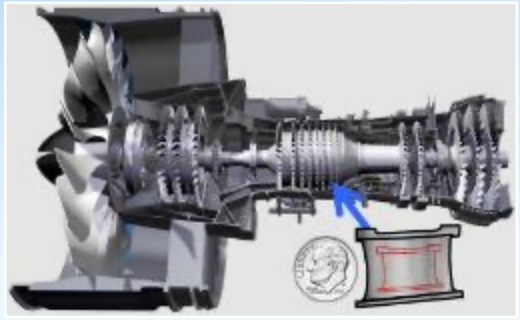
Subsonic Transport Technologies

Ensure U.S. industry is the first to establish the new “S Curve” for the next 50 years of transports

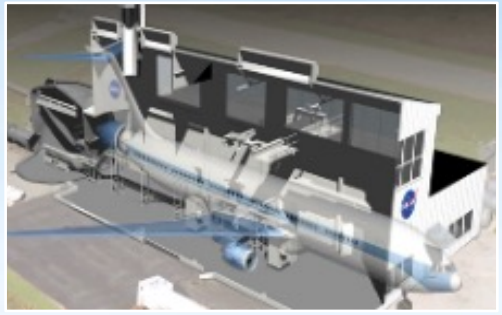




Transonic Truss-Braced Wing
5-10% fuel burn benefit



Small Core Gas Turbine
5-10% fuel burn benefit



Electrified Aircraft Propulsion
~5% fuel burn and maintenance benefit



High-Rate Composite Manufacturing
4x-6x manufacturing rate increase

NASA Transonic Truss Braced Wing (TTBW)

TTBW – “Single Aisle” Advanced Concept

> Can fly 3,500 nautical miles!

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> Can travel at a speed of 0.8 times the speed of sound!

TTBW – “Single Aisle” Advanced Concept

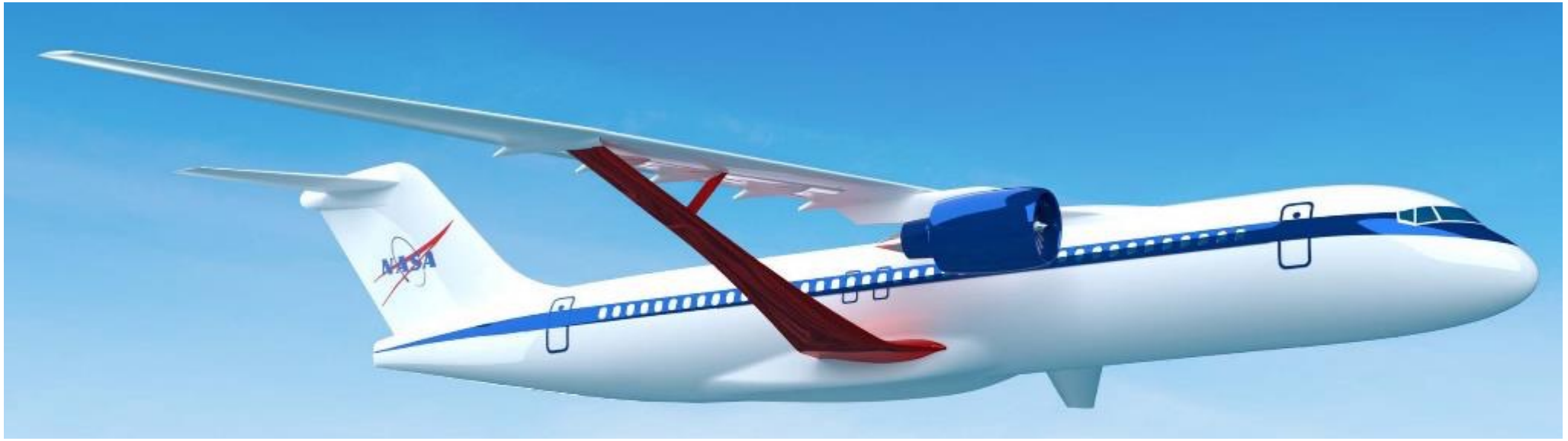
> Can fly 3,500 nautical miles!

> Can travel at a speed of 0.8 times the speed of sound!

> Can do all of this while carrying 154 passengers and gear!

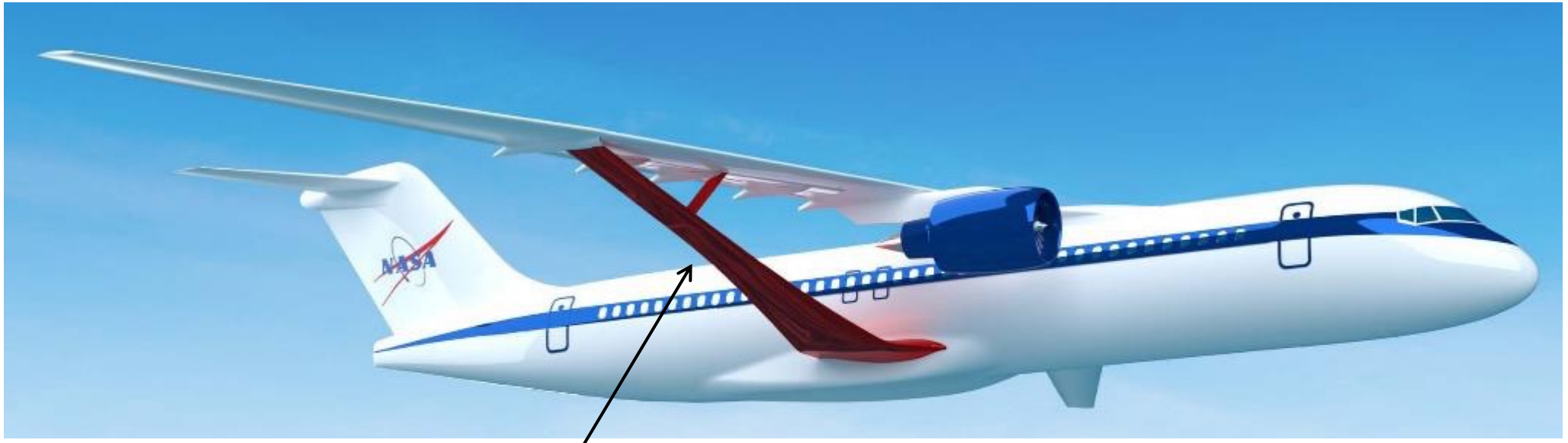
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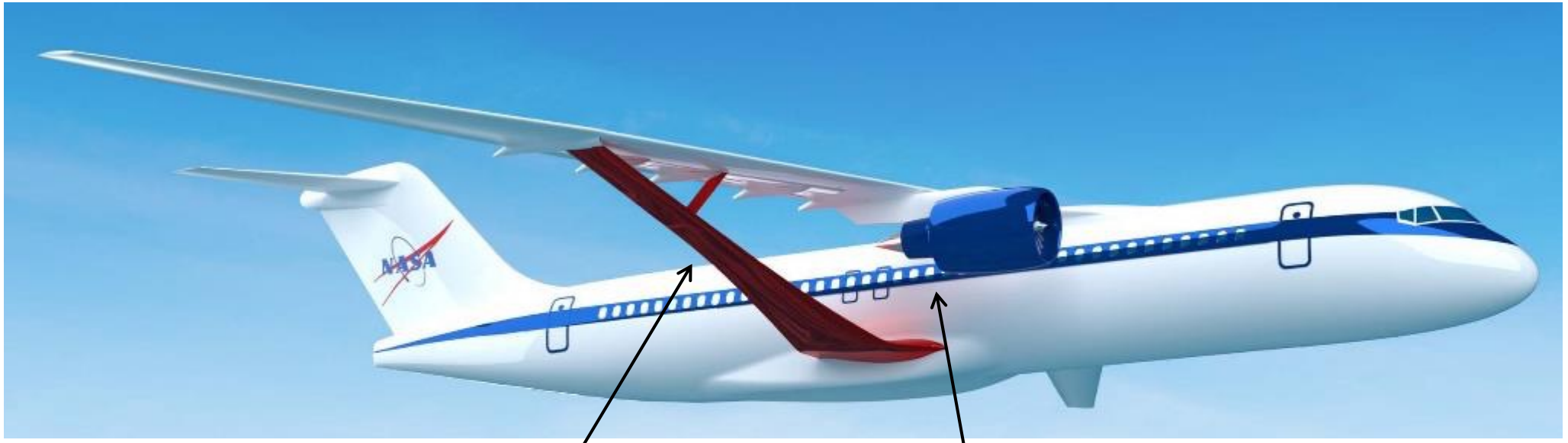
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Truss-Braced Wing to Reduce Weight and Increase Lift-to-Drag

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Truss-Braced Wing to Reduce Weight and Increase Lift-to-Drag

High Wing Allows for Larger, More Efficient Engines

NASA N3-X Hybrid Wing Body (HWB)

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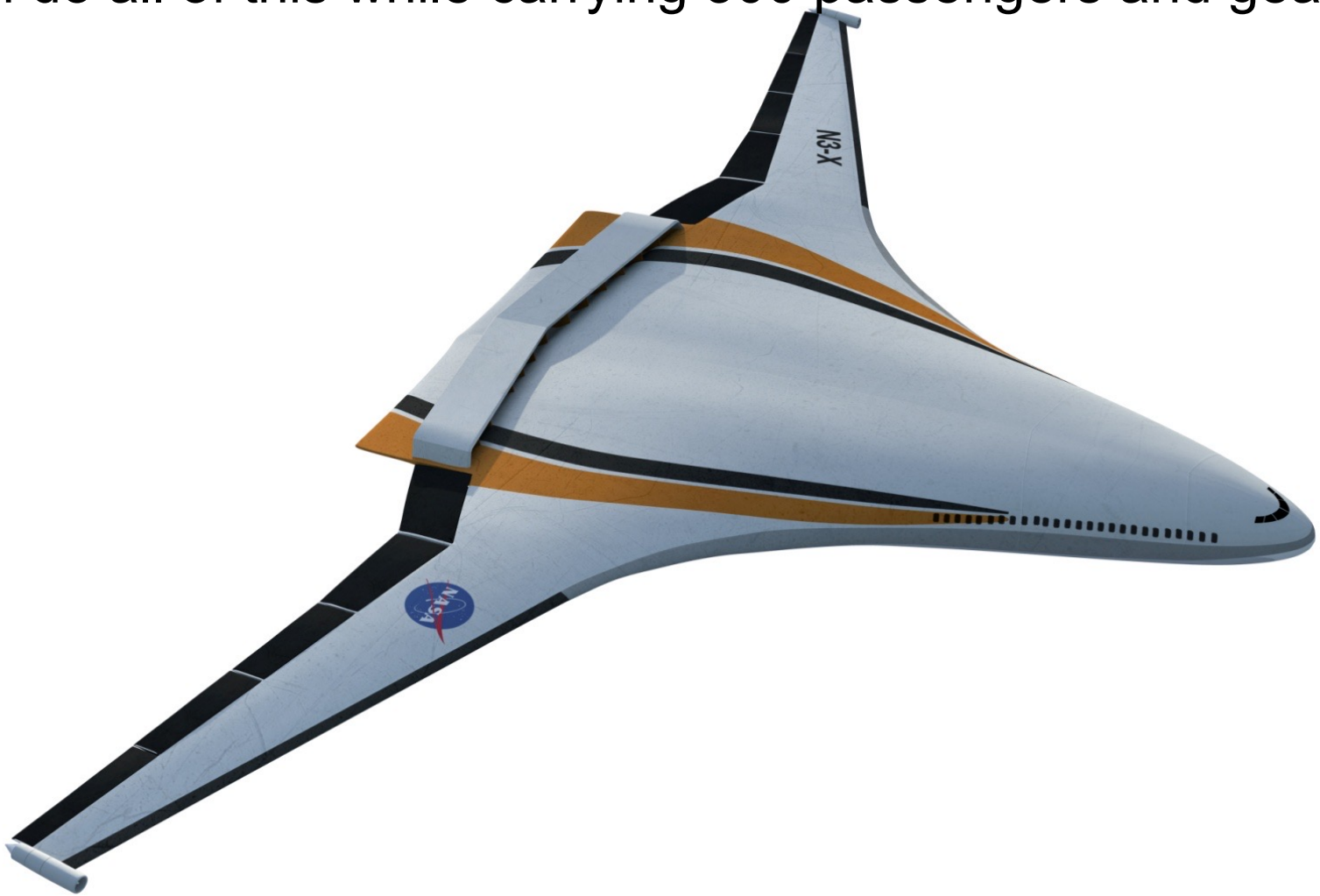
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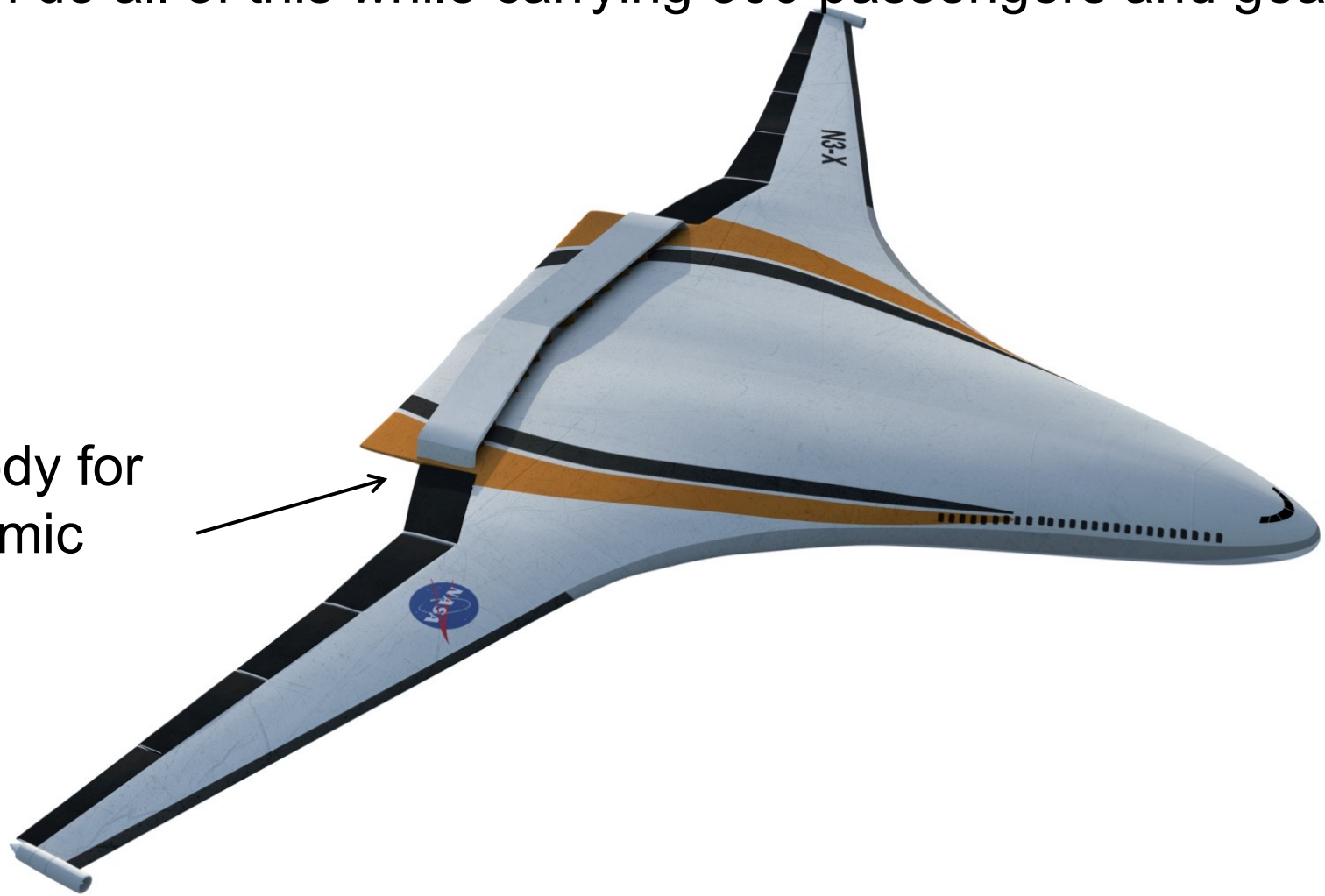
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Blended Wing/Body for High Aerodynamic Efficiency



NASA N3-X

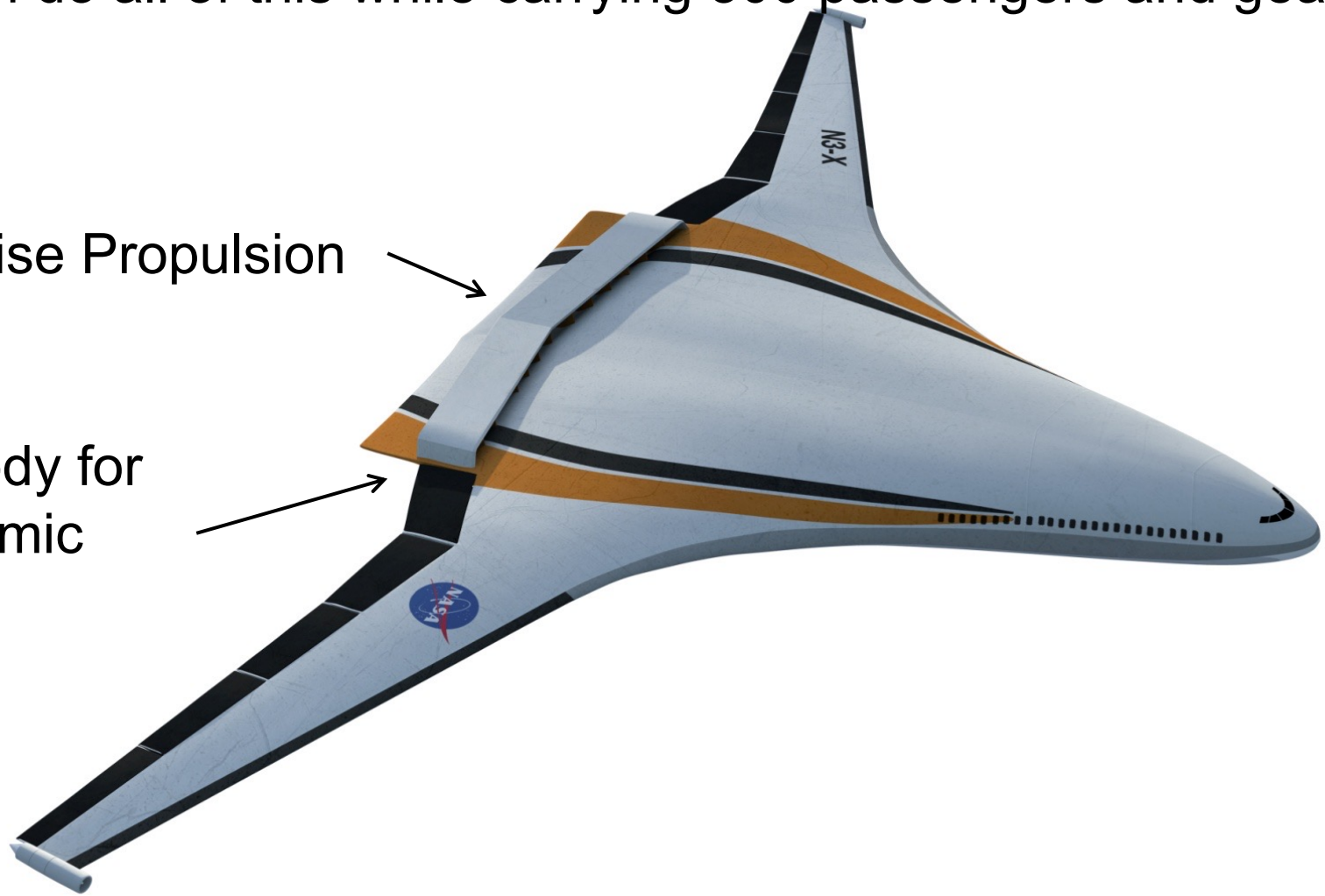
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Low Noise Propulsion

Blended Wing/Body for High Aerodynamic Efficiency



NASA N3-X

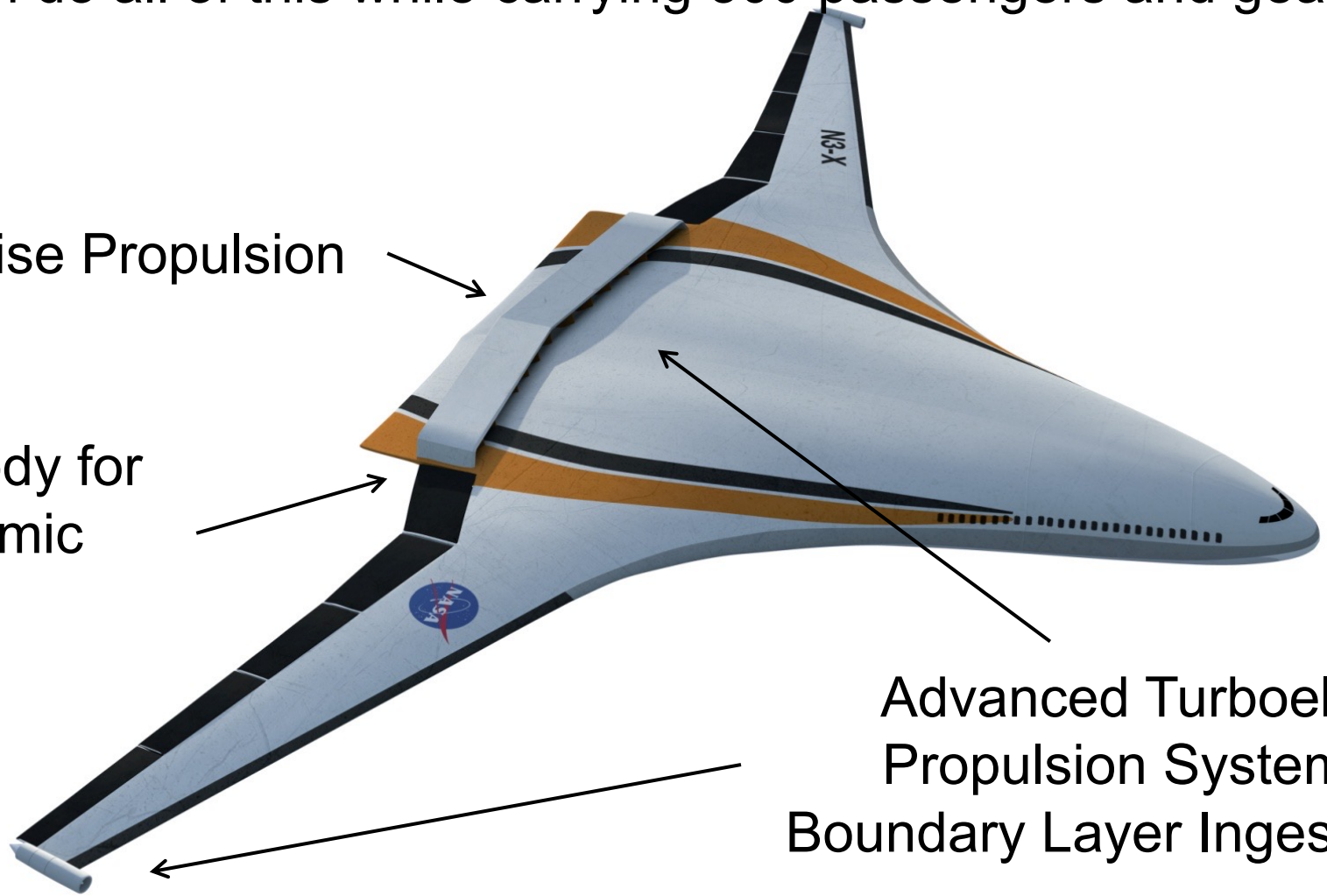
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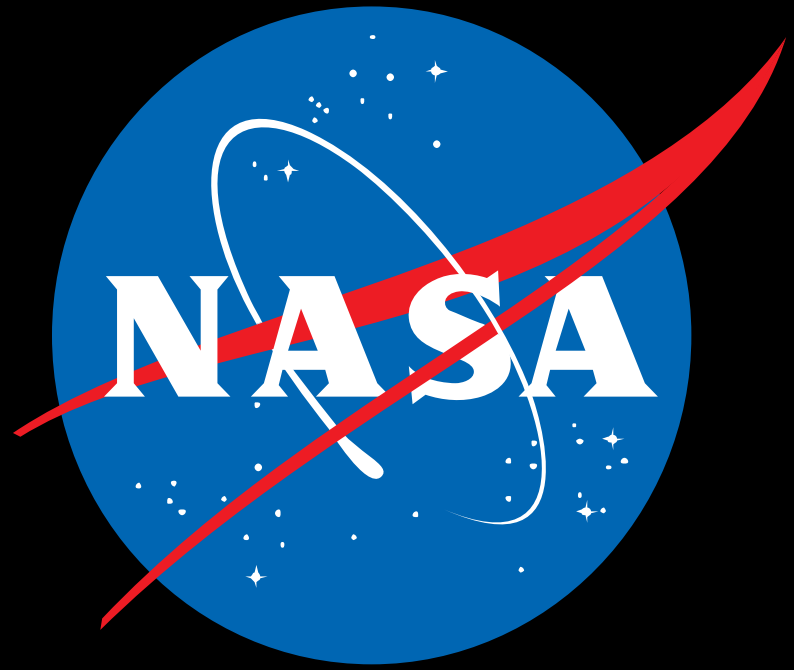
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Low Noise Propulsion

Blended Wing/Body for High Aerodynamic Efficiency



Advanced Turboelectric Propulsion System with Boundary Layer Ingestion (BLI)


NASA