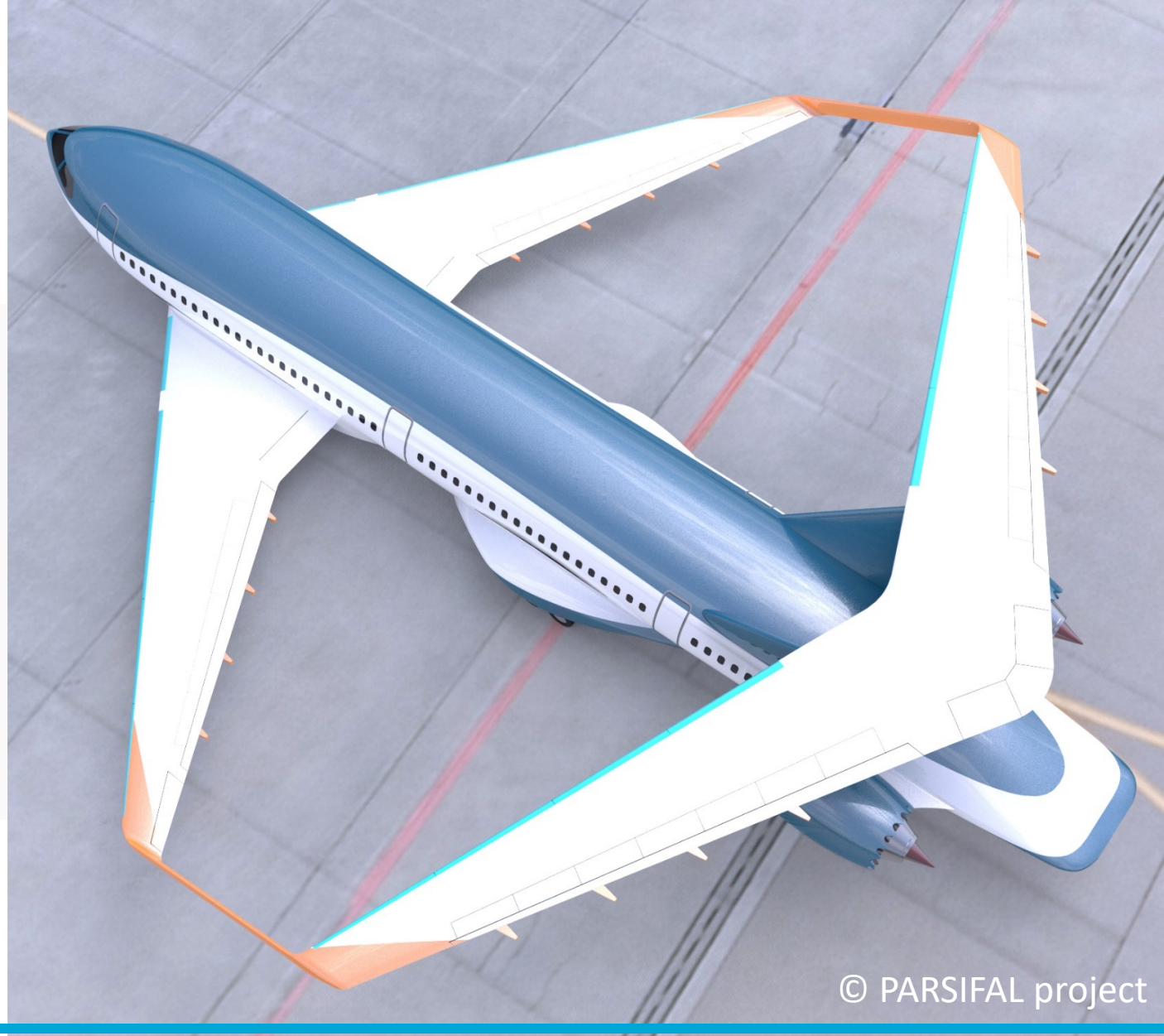# The box-wing aircraft
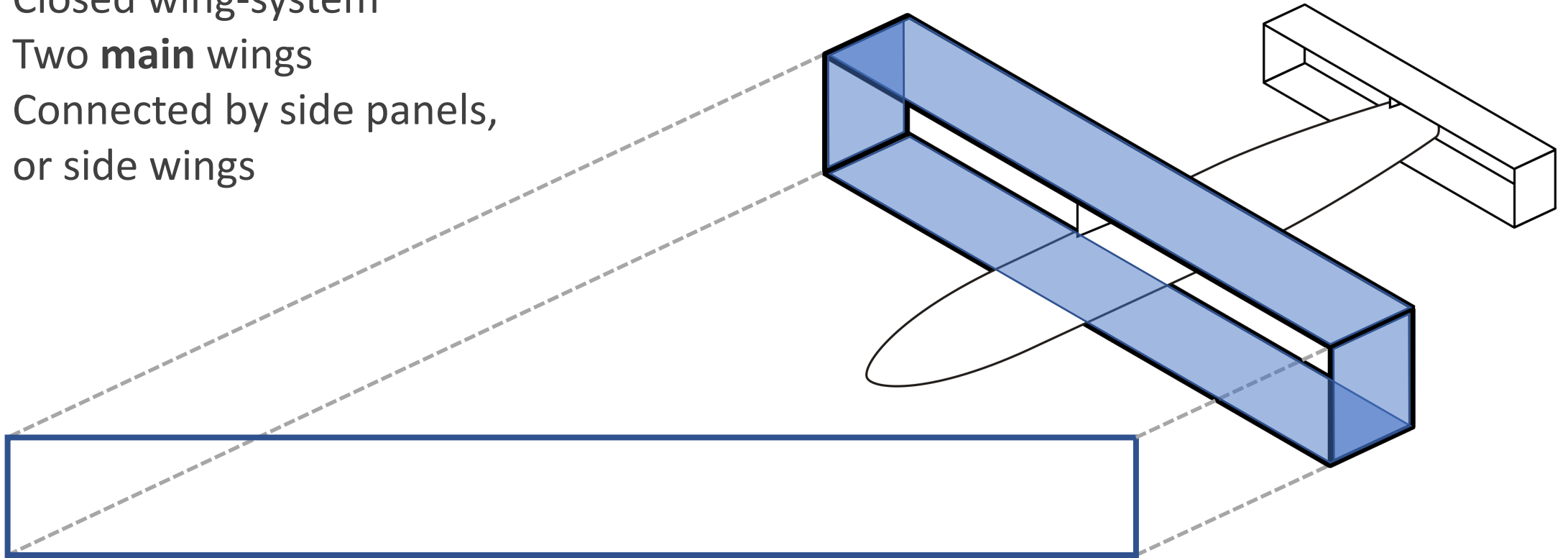
Carmine Varriale
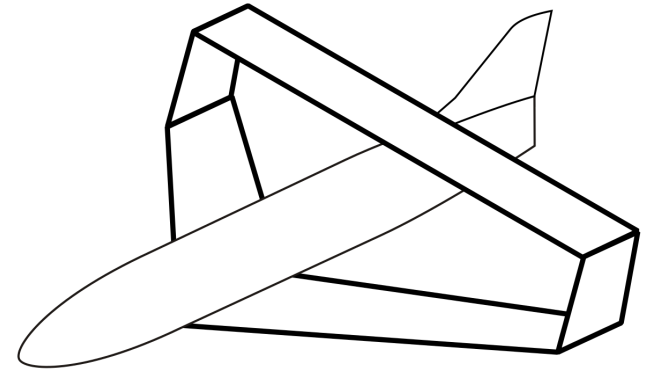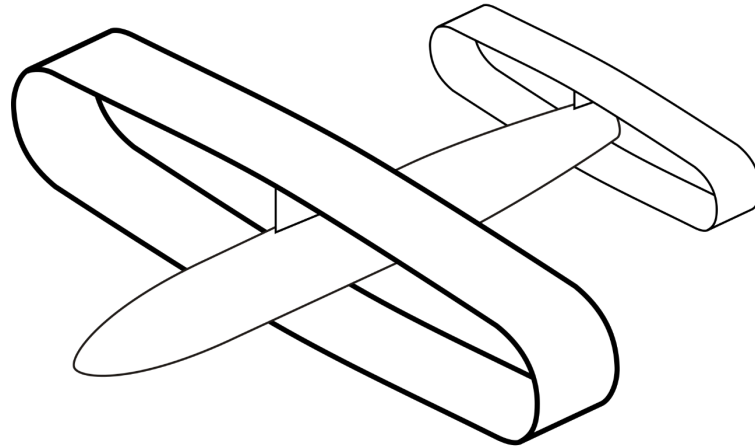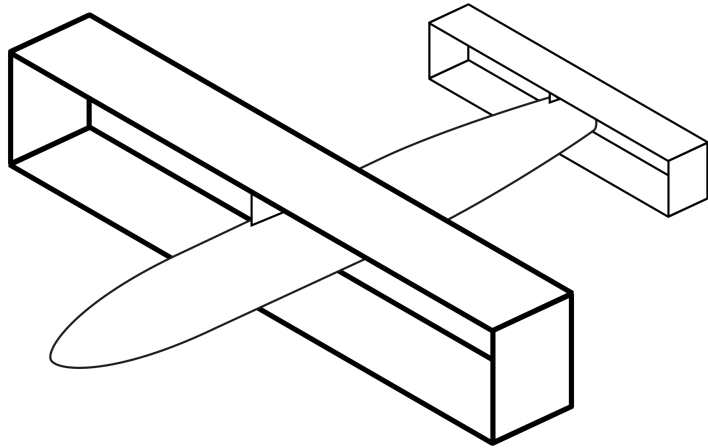
TUDelft

What is a box-wing?

- Closed wing-system
- Two **main** wings
- Connected by side panels, or side wings

What is a box-wing?
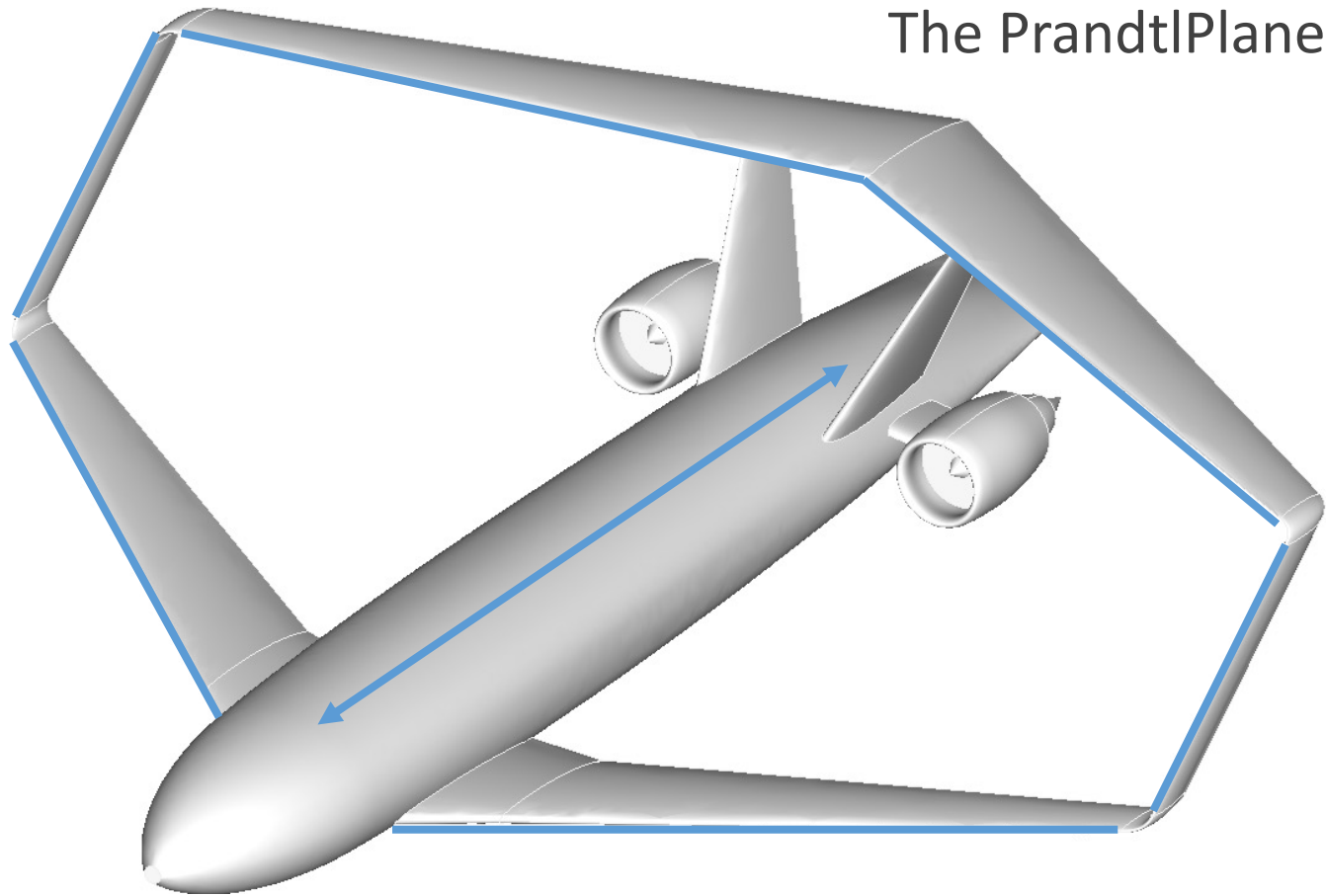
Examples
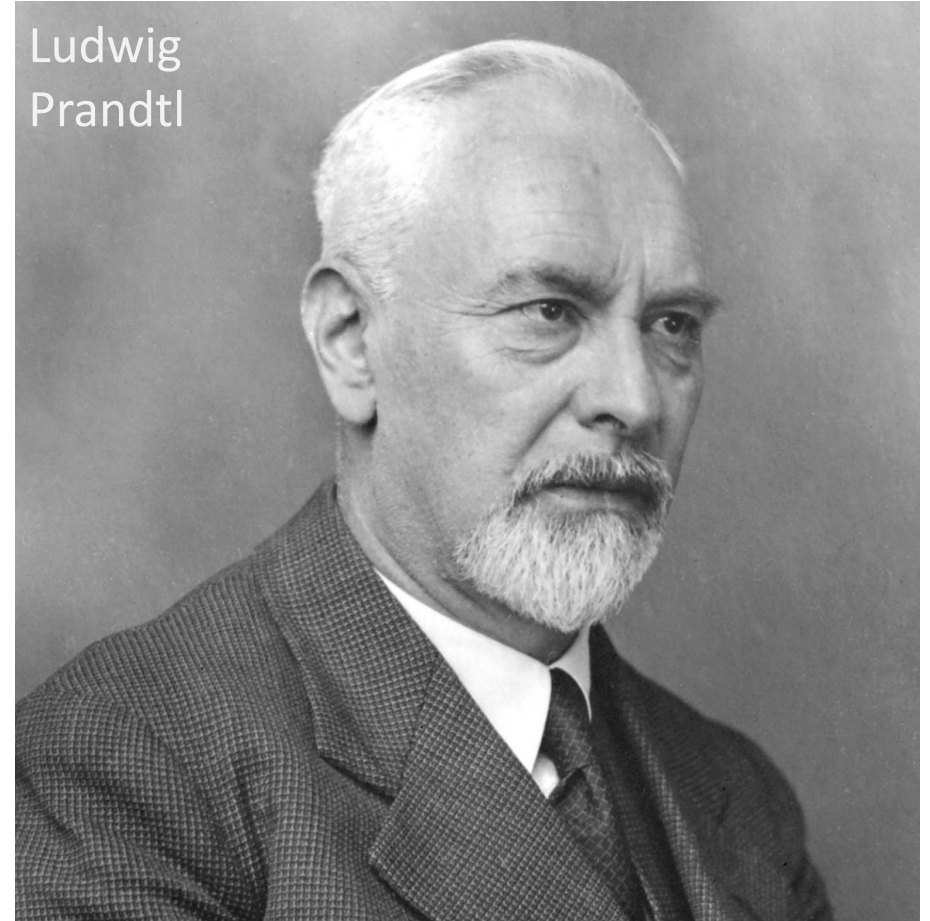

Ligeti Stratos

Airkraft Sunny

Transonic flight

The PrandtlPlane

Ludwig
Prandtl

Box-wing aerodynamics

The box-wing achieves **minimum induced drag** for a given span and weight

b

TUDelft
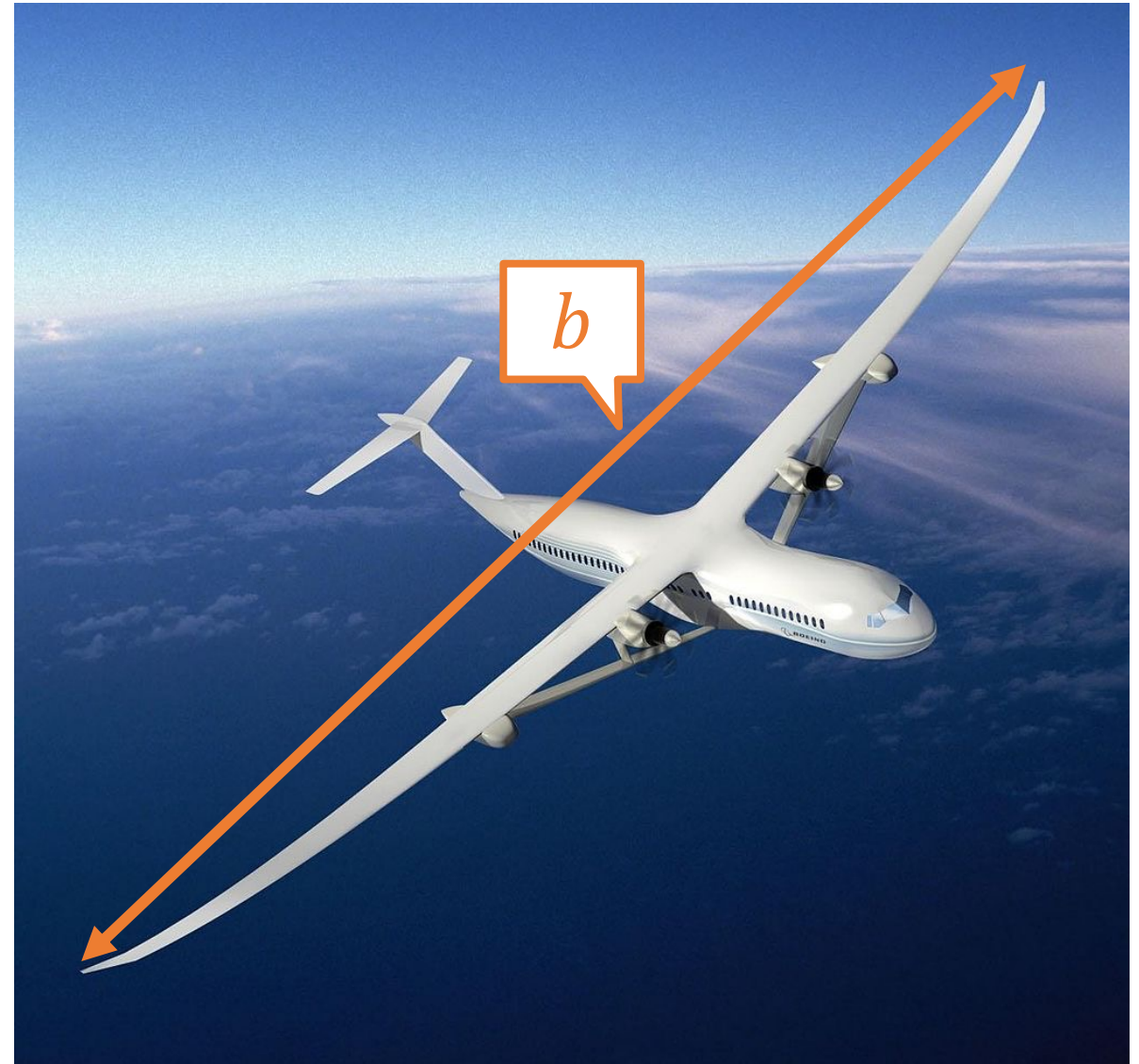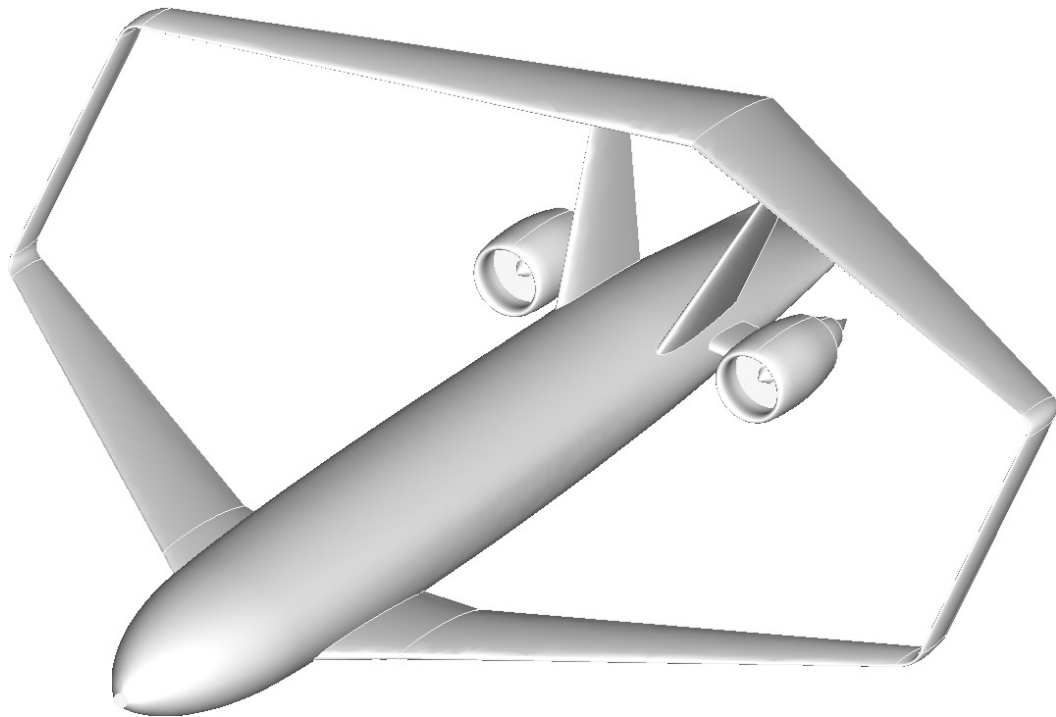
Box-wing aerodynamics

The box-wing achieves **minimum induced drag** for a given span and weight
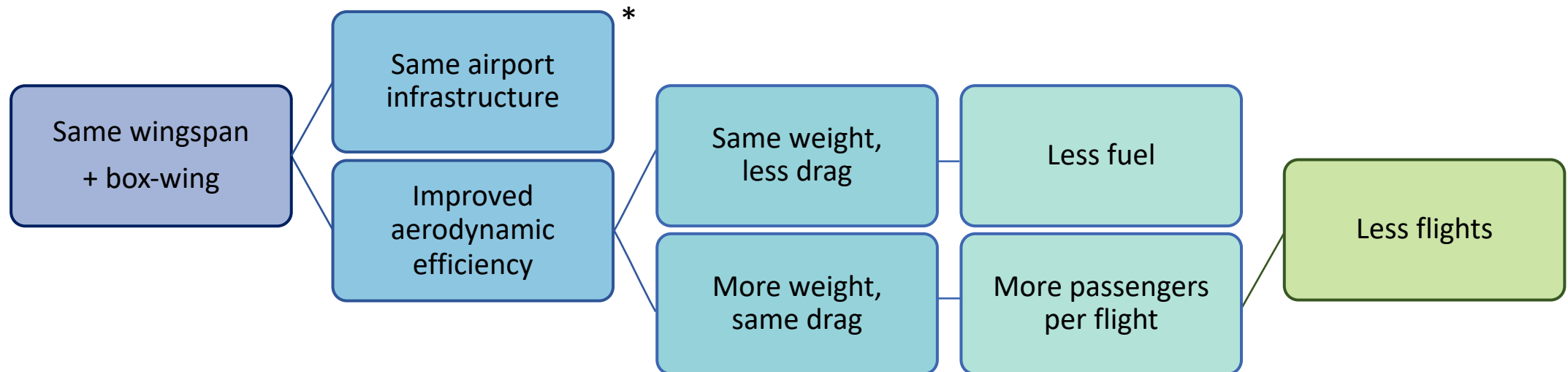
Box-wing aerodynamics

The box-wing achieves **minimum induced drag** for a given span and weight

TU Delft

How does the PrandtlPlane help?
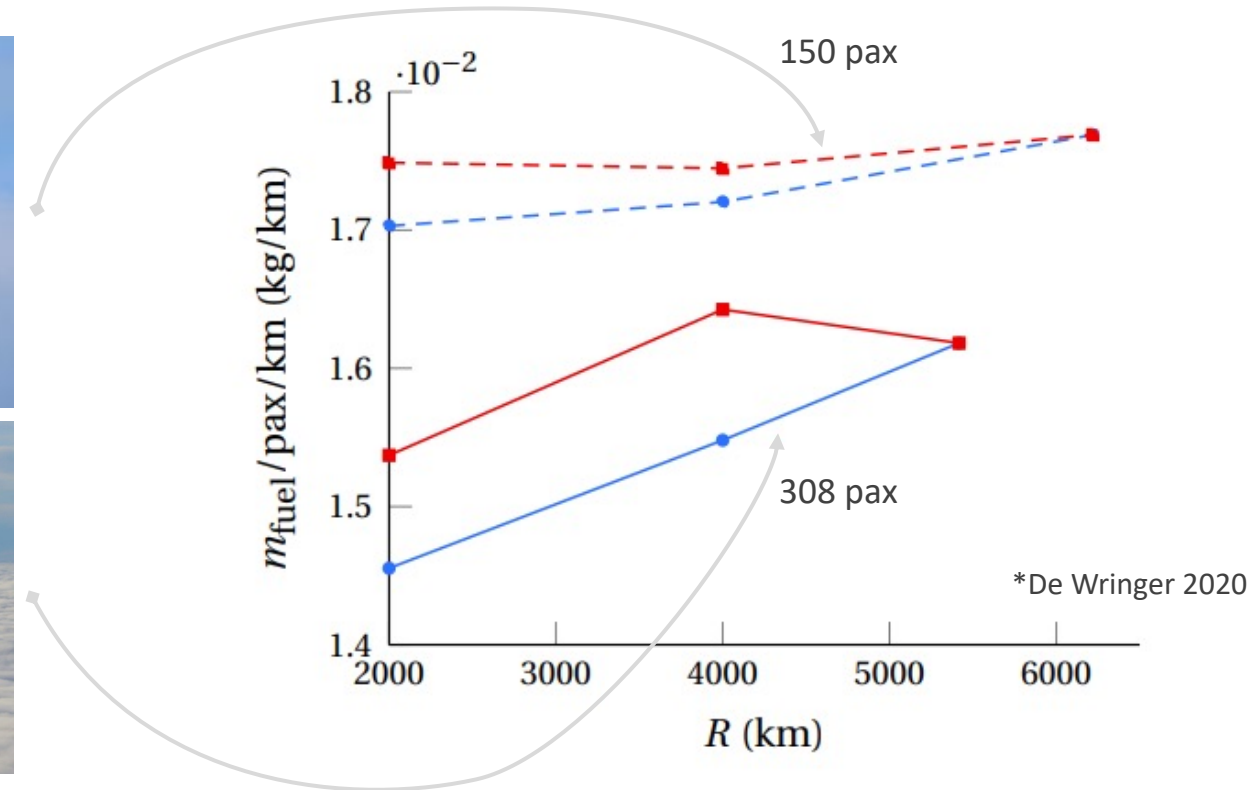

Airbus A320 family

Boeing 737 family

Same wingspan + box-wing

Same airport infrastructure *

Improved aerodynamic efficiency

Same weight, less drag

Less fuel

More weight, same drag

More passengers per flight

Less flights

Mission performance comparison

Airbus A320

PrandtlPlane © PARSIFAL project

150 pax

308 pax

*De Wringer 2020
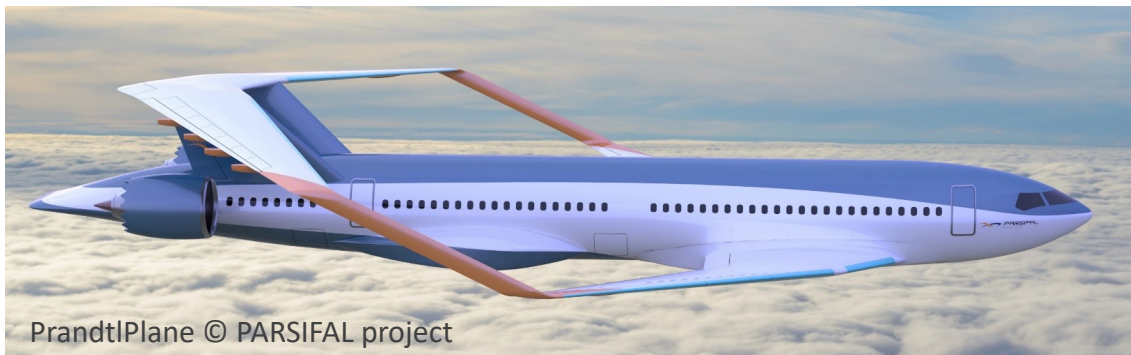
The PrandtlPlane uses **less fuel per passenger** to move **more passengers** on a short-medium range route

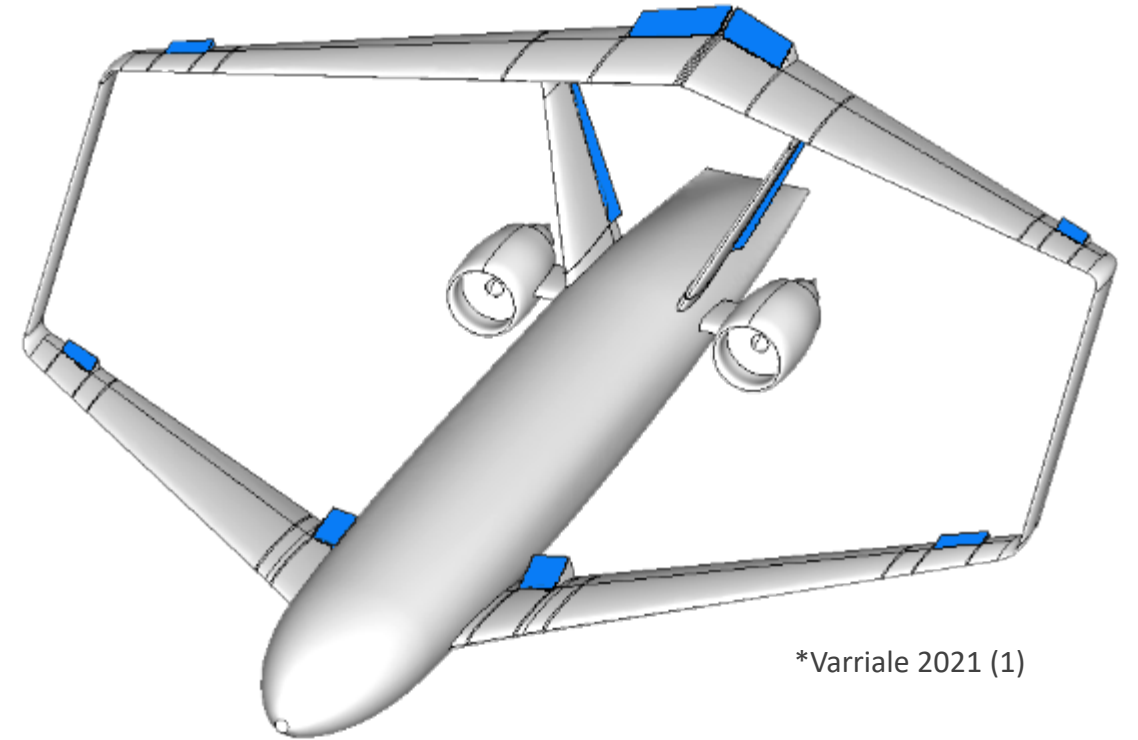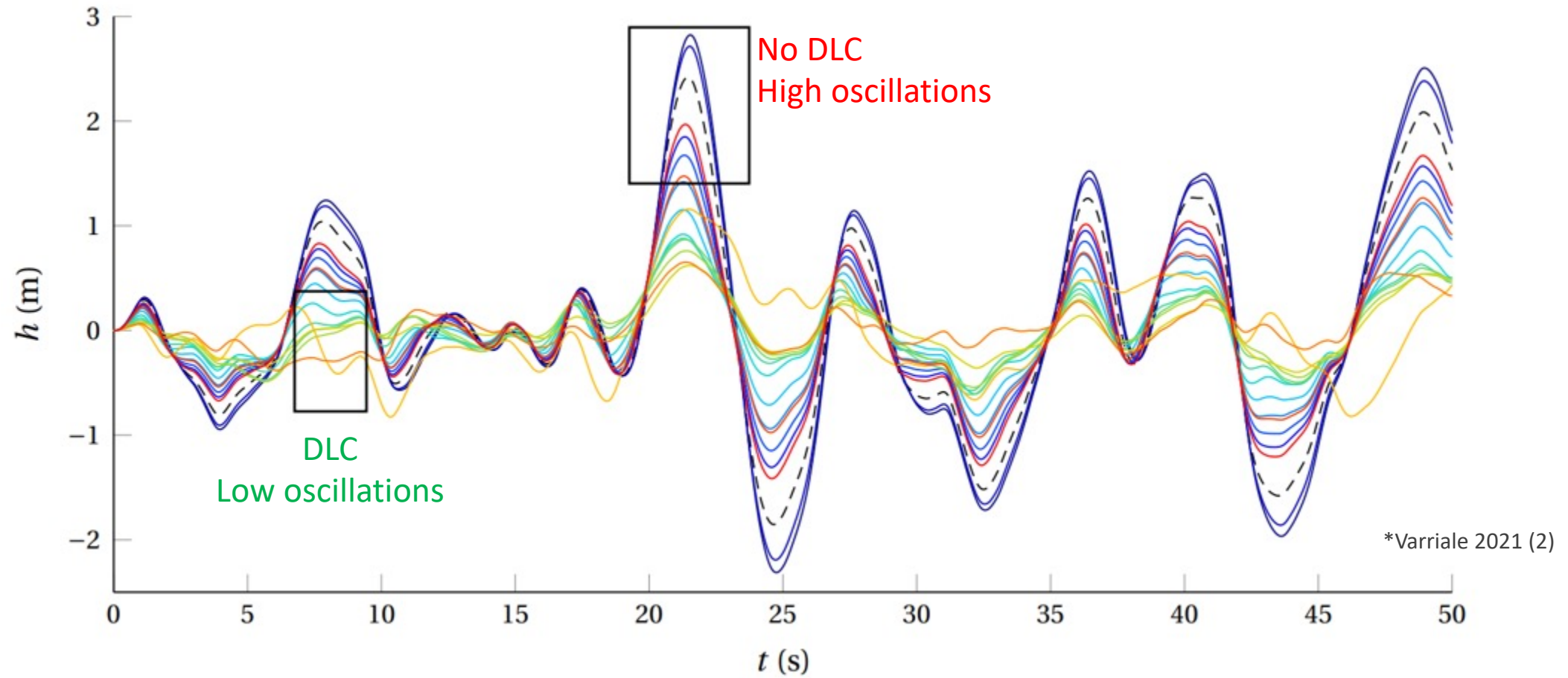# Redundant control surfaces

- Infinite possibilities to maneuver
- Optimal dynamic performance

- Direct Lift Control (DLC)
- Dynamic response is
  - More precise
  - More agile
  - Faster

*Varriale 2021 (1)

Comfort and Safety

No DLC
High oscillations

DLC
Low oscillations

*Varriale 2021 (2)

Summary

- The box-wing achieves minimum induced drag, regardless of its shape

- The PrandtlPlane transports 2x passengers of the A320, with less fuel/passenger and same wingspan

- Redundant control surfaces allow Direct Lift Control, which results in
  - more comfort and safety in flight
  - more precision and lower noise in descent and landing