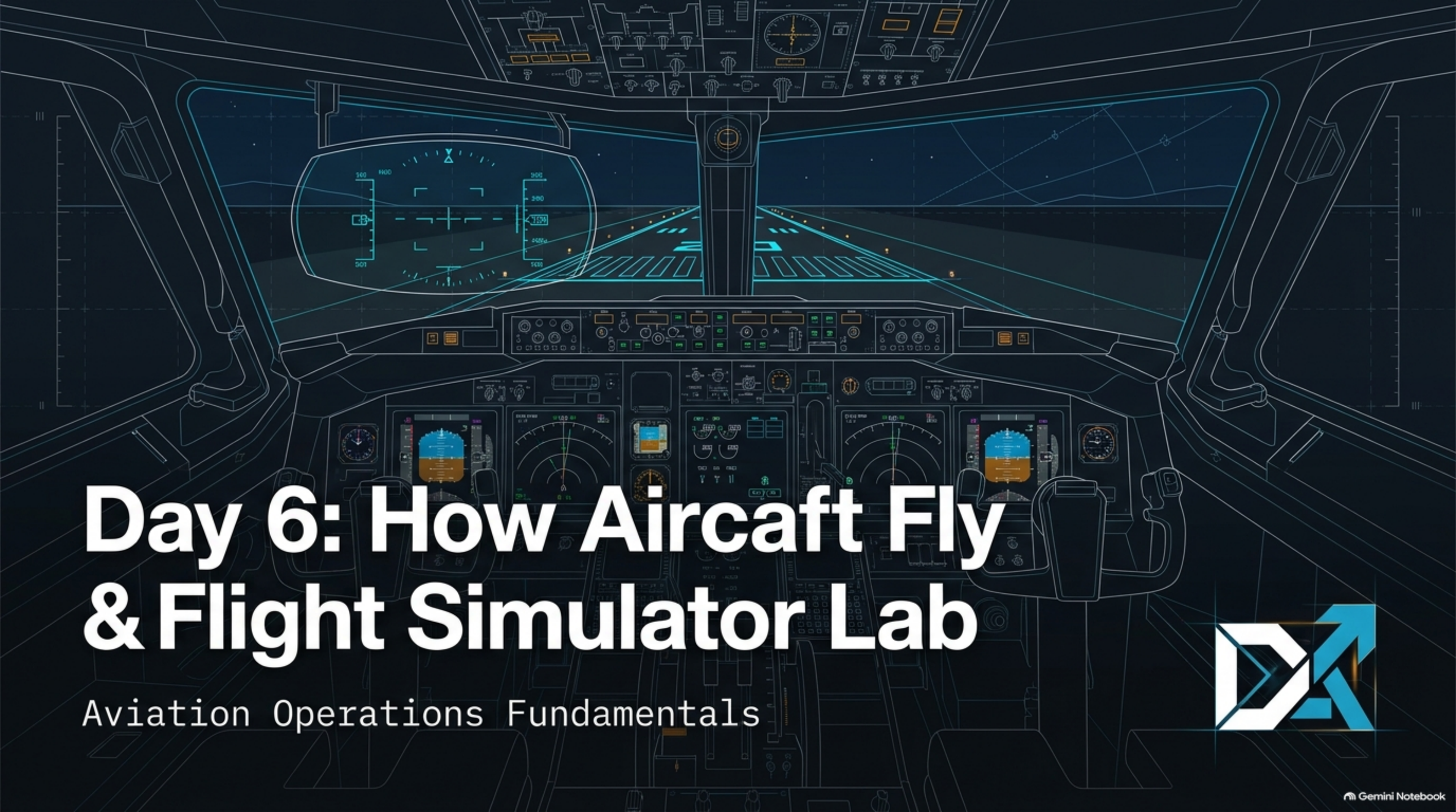
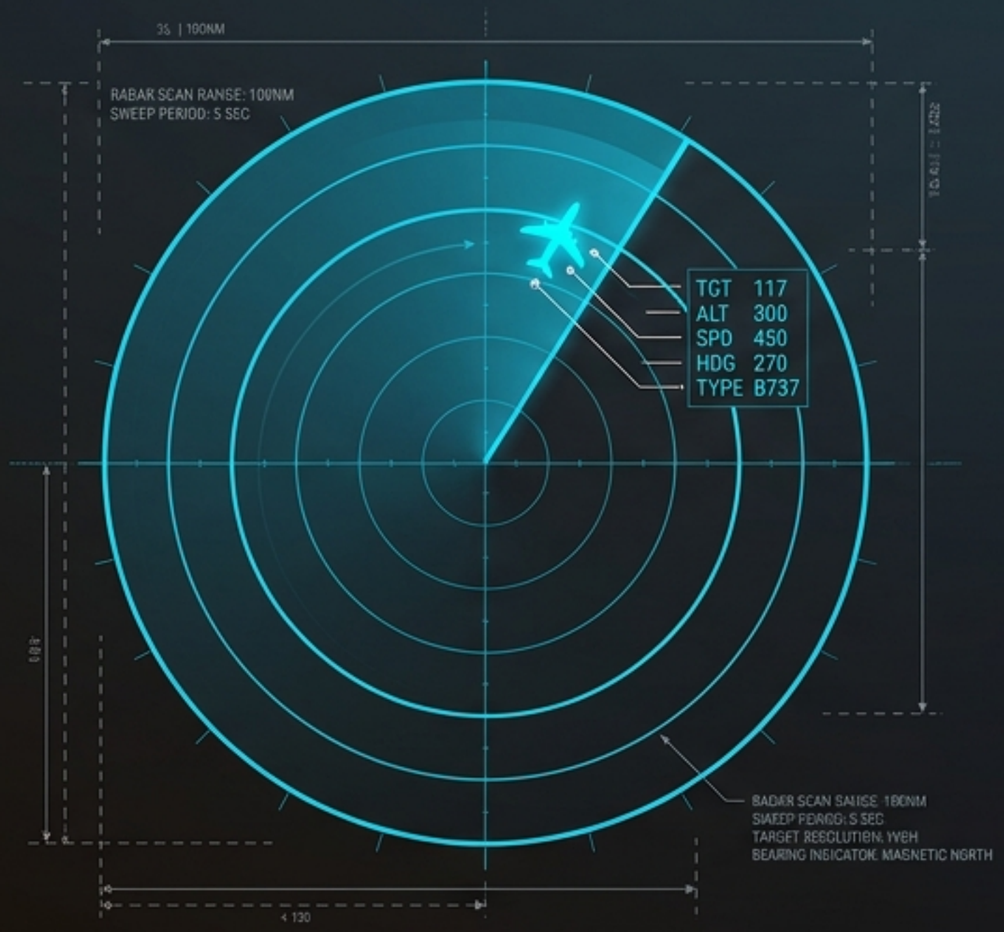


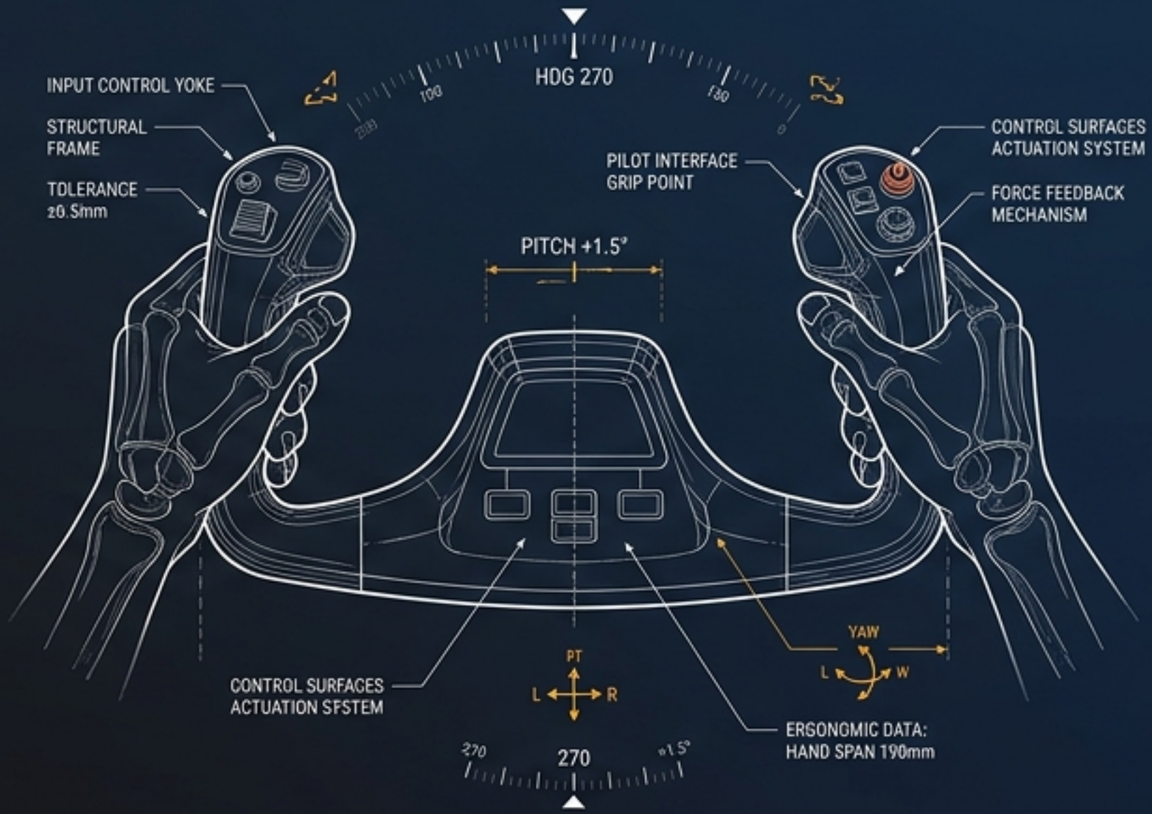
Day 6: How Aircaft Fly & Flight Simulator Lab

Aviation Operations Fundamentals

Gemini Notebook

The Empathy Principle





You don't need to be a pilot to control traffic well. But you must understand what the aircraft you are directing can and cannot do. The goal is intuitive empathy. Every instruction you give must respect the physical reality of the pilot executing it.

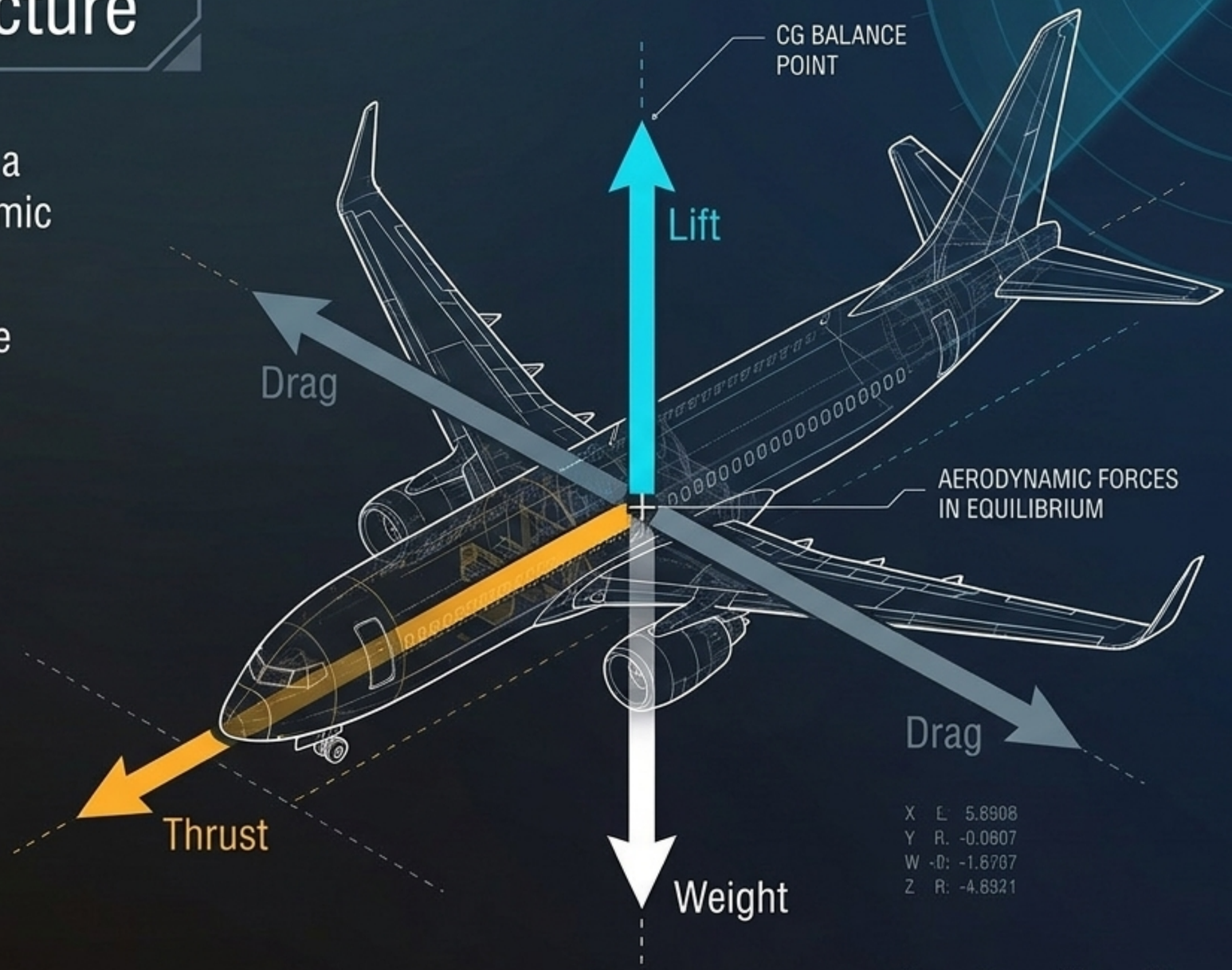
Gemini Notebook

The Invisible Architecture

Every aircraft in flight is managed by a continuous balance of four aerodynamic forces.

In steady, level flight, these forces are in equilibrium:

- Lift balances Weight.
- Thrust balances Drag.

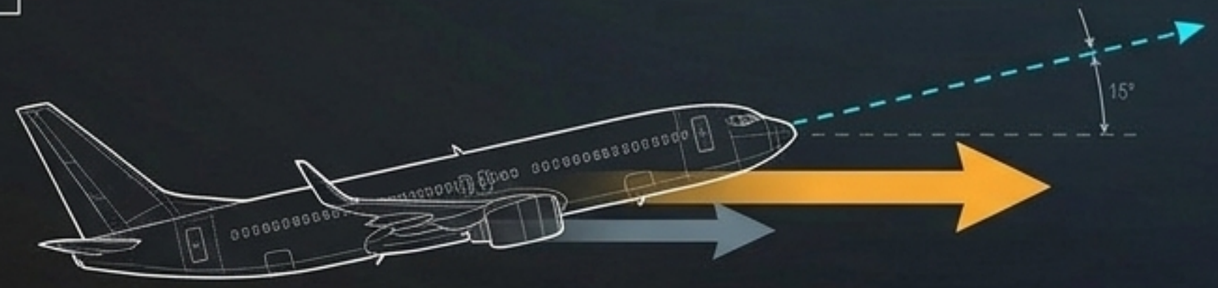
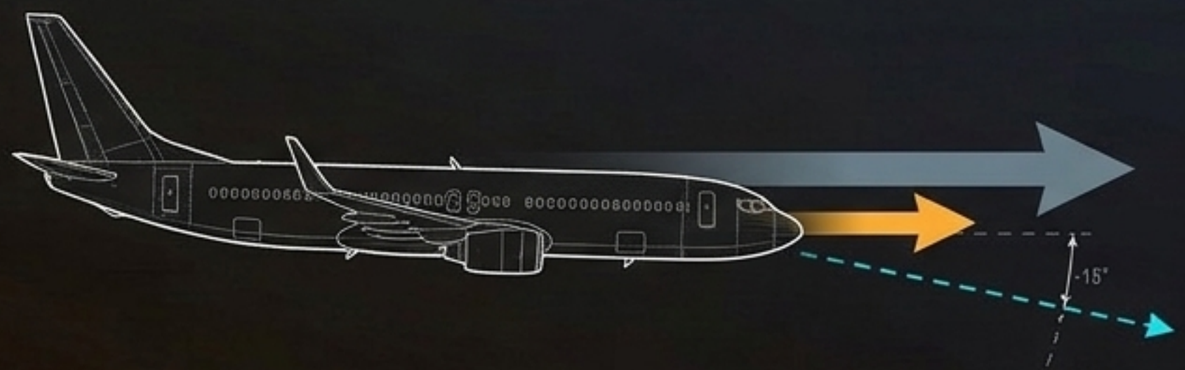


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Breaking the Balance

Aircraft maneuver by intentionally shifting the balance of forces.

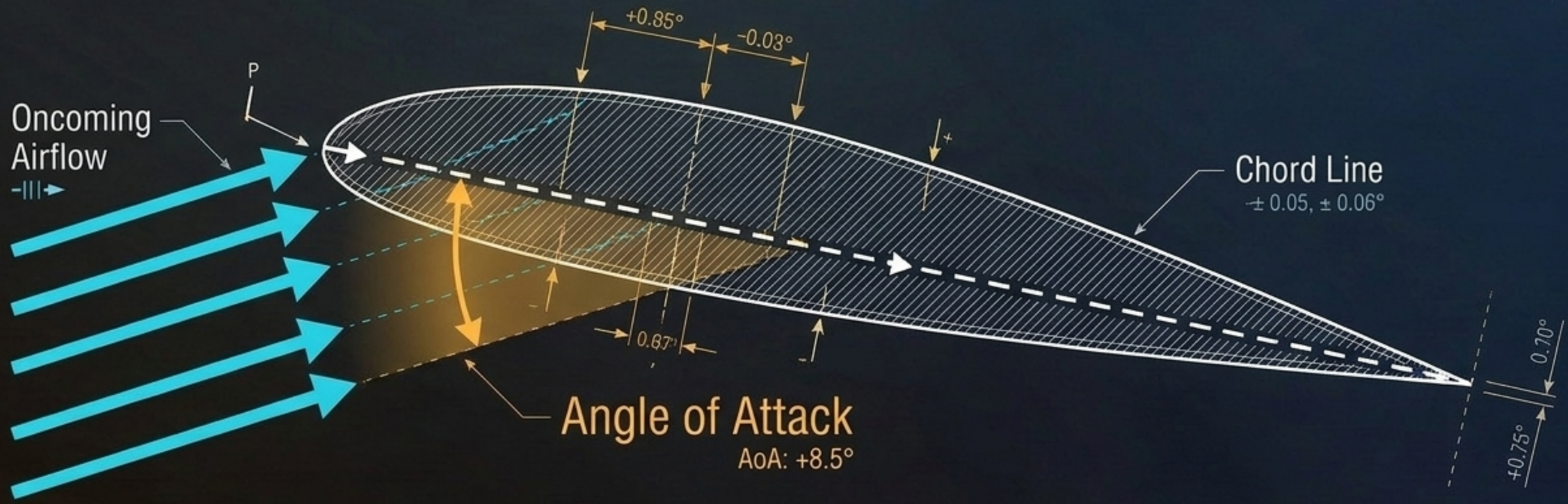
Force Imbalance Matrix

1 	- Thrust > Drag: If thrust increases while pitch remains constant, the excess forward energy converts into altitude gain. The aircraft climbs.
2 	- Drag > Thrust: If drag increases while thrust remains constant, forward energy bleeds off. The aircraft descends.

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Angle of Attack (AoA)

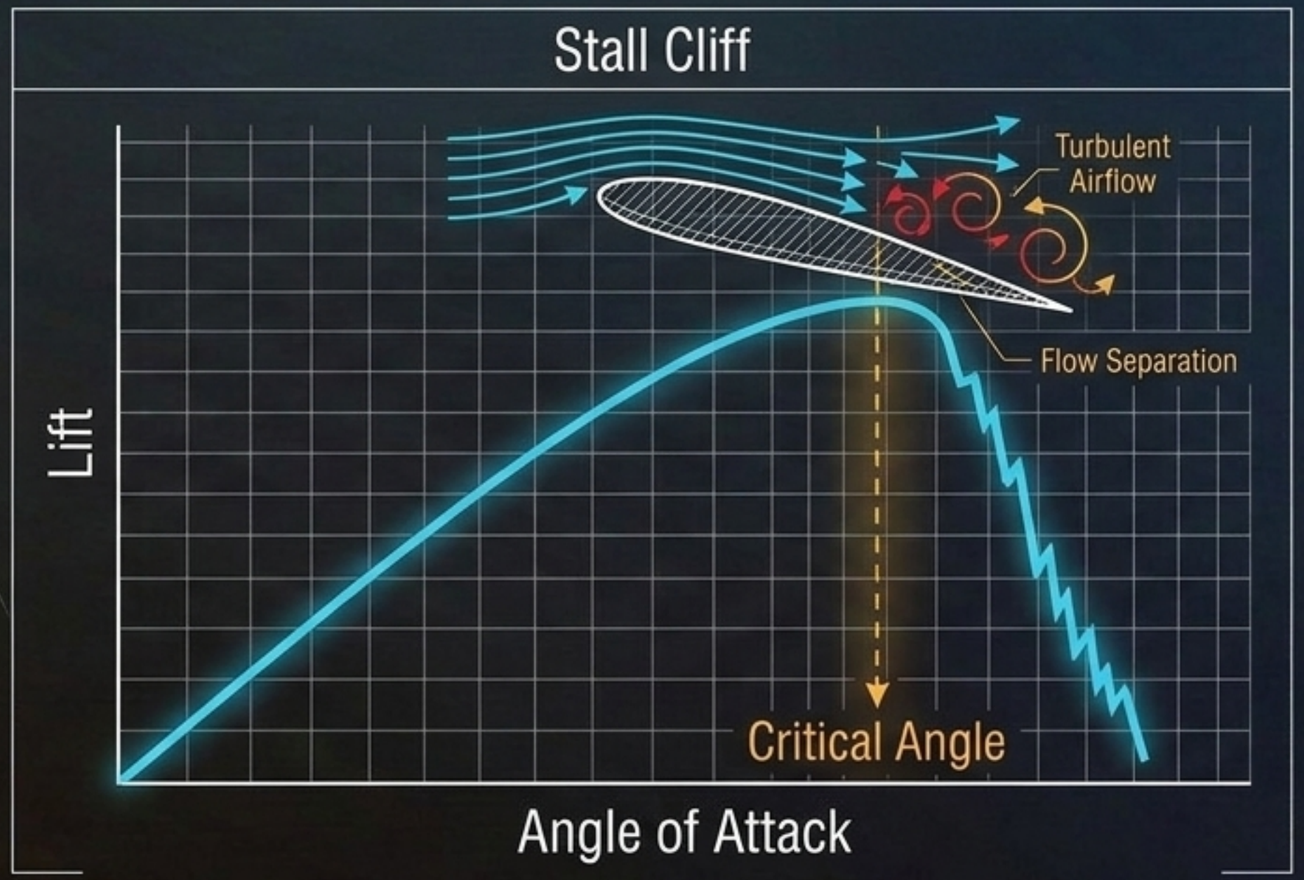
Lift generated by the wings depends heavily on the Angle of Attack—the exact angle between the wing's chord line and the oncoming airflow.



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Exceeding the Critical Angle

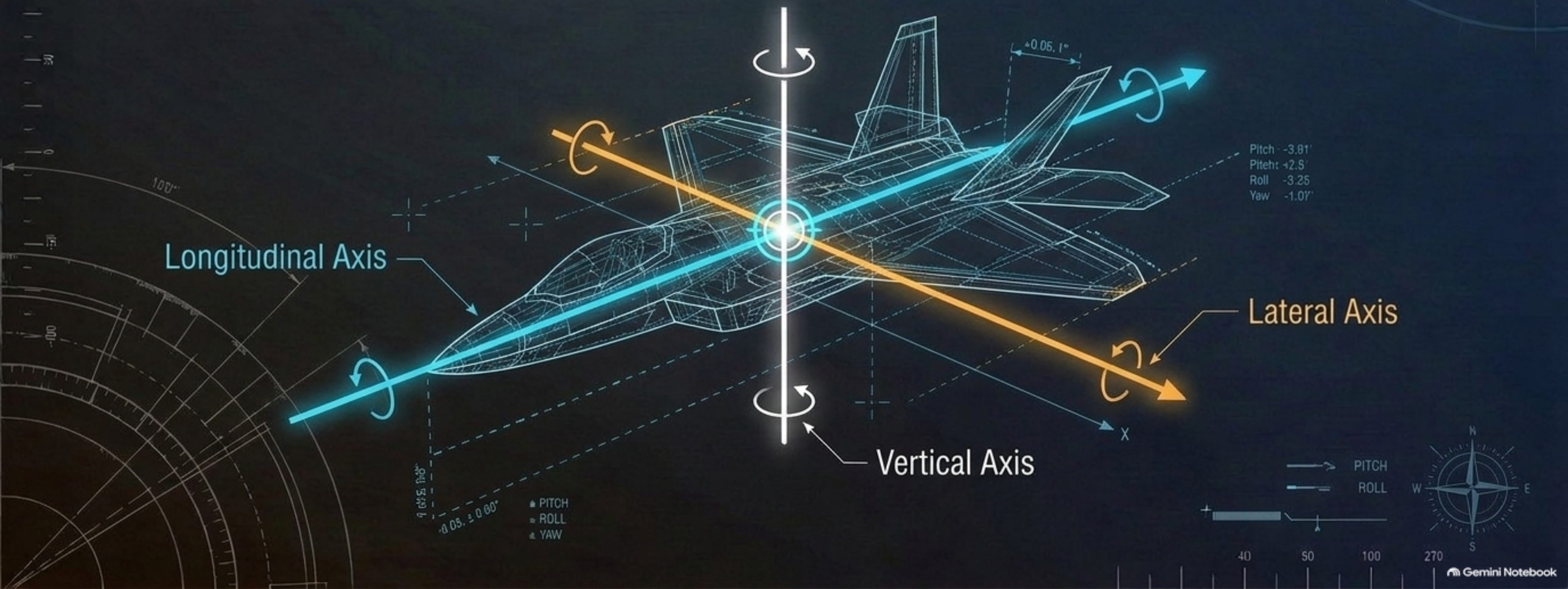
Push the Angle of Attack too far, and the wing can no longer produce enough lift. This is a Stall: a complete loss of lift caused by exceeding the critical angle of attack. It is driven by angle, not just raw airspeed.



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The Pilot’s 3D Environment

Pilots manage the forces of flight by manipulating the aircraft around three distinct axes of rotation. Every movement in the sky occurs around these intersecting lines.



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Commanding the Machine

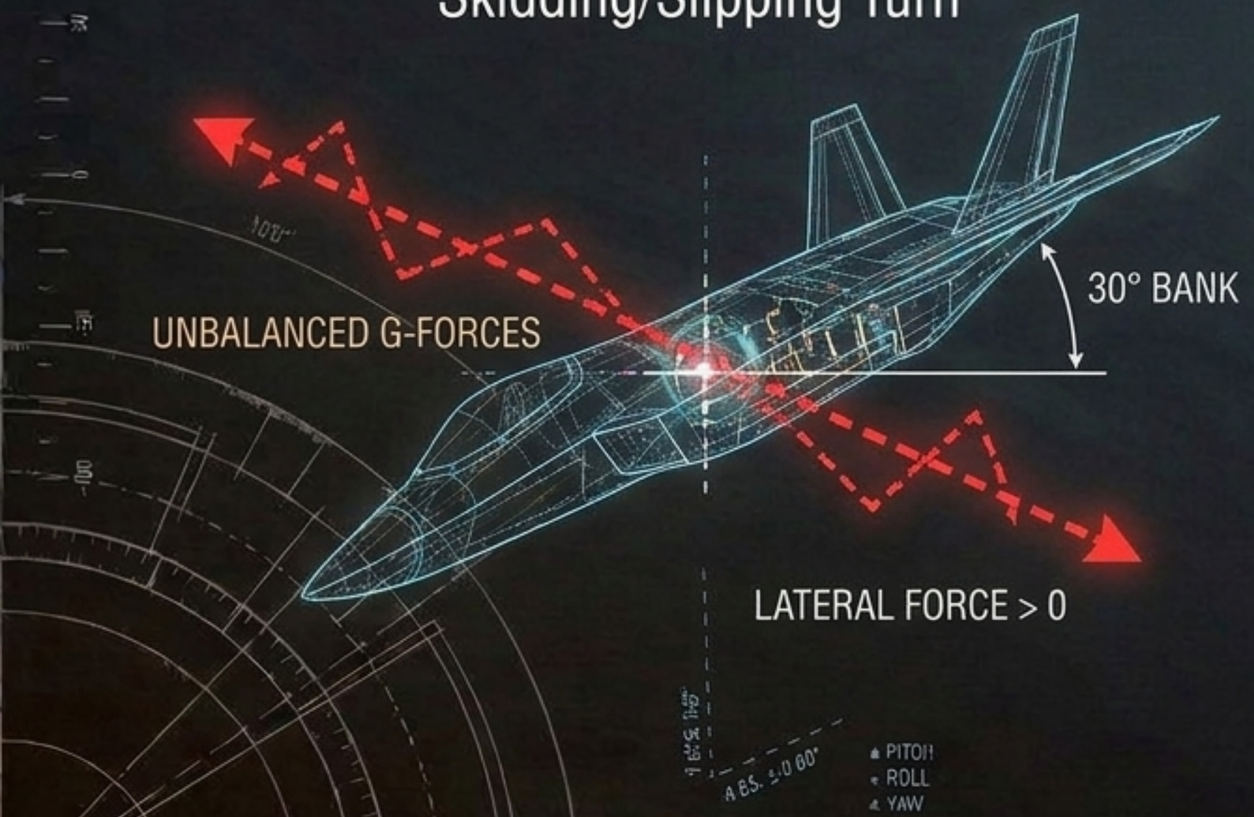
Control Surface	Resulting Motion	Axis of Rotation
Ailerons 	Roll (Banking left/right)	Longitudinal
Elevator 	Pitch (Nose up/down)	Lateral
Rudder 	Yaw (Nose turning left/right)	Vertical

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The Mechanics of a Turn

An aircraft cannot turn instantly. A smooth, balanced turn requires coordinated input from both the Ailerons (to establish the bank angle) and the Rudder (to keep the motion smooth).

Skidding/Slipping Turn



Coordinated Turn



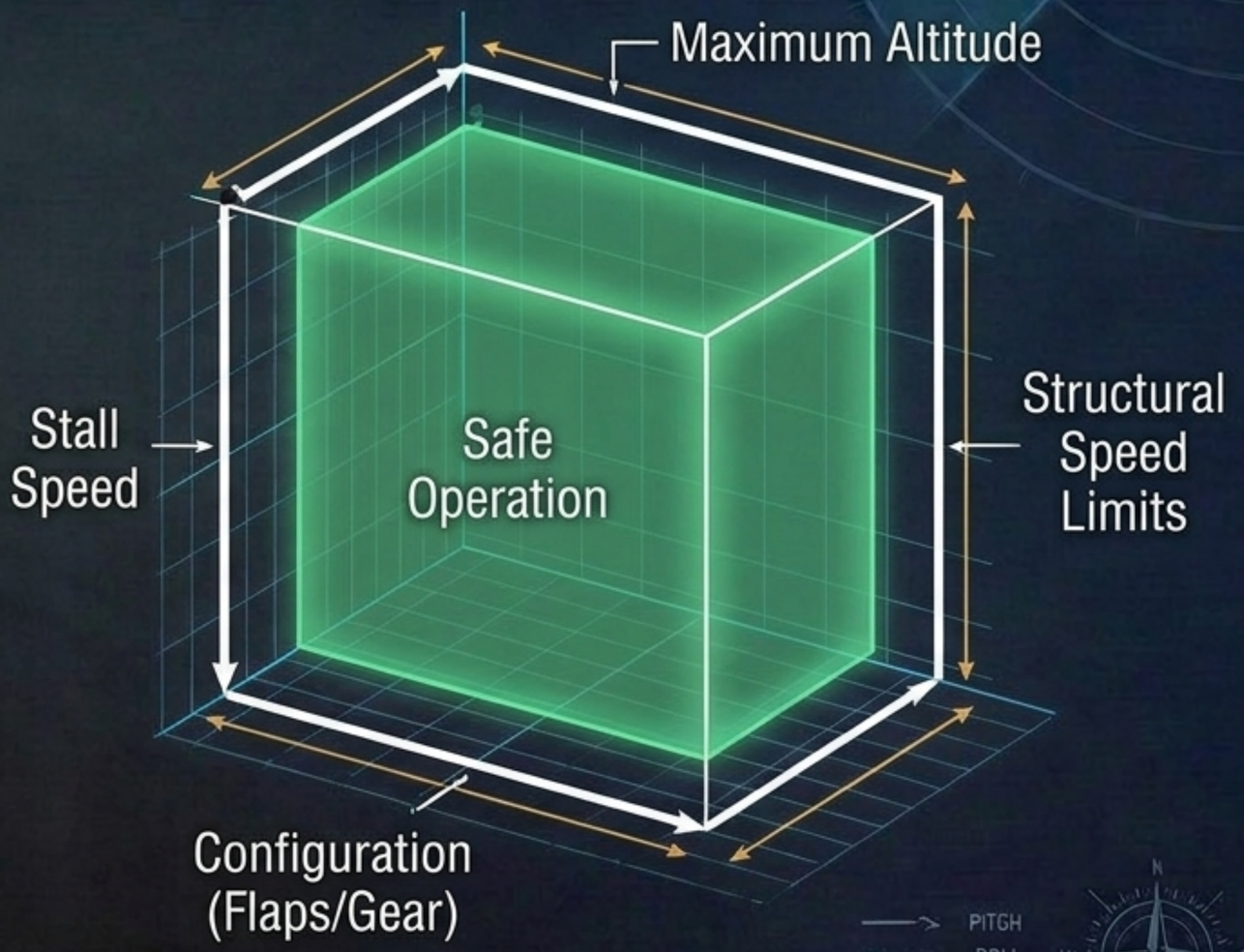
Gemini Notebook

The Performance Envelope

The forces dictate the rules. The controls navigate the rules. The envelope is the absolute boundary.

The Performance Envelope defines the specific range of airspeeds, altitudes, and configurations where the aircraft can safely operate.

Every climb, descent, turn, and speed change instruction you issue must fit safely inside this envelope.



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Transition to the Simulator Lab

Today’s mission: Sit in the exact seat of the person whose flight you will one day help manage. Empathy becomes intuitive.



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Lab Drill & Flight Tolerances

Complete the guided flight sequence to standard:

1. Straight & Level: Hold stable flight for 60 seconds (Altitude ±100 ft, Heading ±10°).
2. Coordinated Turn: Execute a stable 180° turn without excessive slip or skid.
3. Vertical Control: Perform a stable 1,000 ft climb and descent within defined vertical-speed bands.



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Scoring & The Prediction Station

To pass today's lab, you must meet criteria across two stations:



Simulator Execution

- At least 2 of 3 flight tasks must be maintained within the green tolerance bands.



Controller Combine (Prediction Station)

- You will be shown flight profiles (e.g., "Thrust increases, pitch unchanged, flaps extended"). You must correctly predict the outcome (climb, descent, stall risk) for at least 4 out of 5 profiles.

Note: Safety-conscious flying is mandatory. Remediation pathways via the Simulation Coach are available for standard task failures.

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ATC Translation: The Communications Drill

Applying the physics to the mic. You must respect climb rate factors and the aircraft's physical reality when assigning altitude.

1. Controller: "Aircraft One, climb and maintain five thousand."

2. Aircraft: "Climb and maintain five thousand, Aircraft One."

3. Controller: "Aircraft One, report reaching five thousand."

4. Aircraft: "Wilco, Aircraft One."

5. Aircraft (later): "Aircraft One, level five thousand."

6. Controller: "Aircraft One, roger."

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Debrief & Daily Challenge

Your MSFS tolerance results will be converted to a composite score and posted to the ‘First Flight’ eSports Hub Leaderboard, seeding you for Day 10.

☑ **LMS Requirements:**

- Upload Simulator & Prediction Station scores.
- Submit diagram labeling assignment.
- Complete the 15-item Knowledge Check.

Reflection: How does physically feeling the aircraft’s limitations change the kind of instruction you will give as a controller?



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