THE SLEIPNIR

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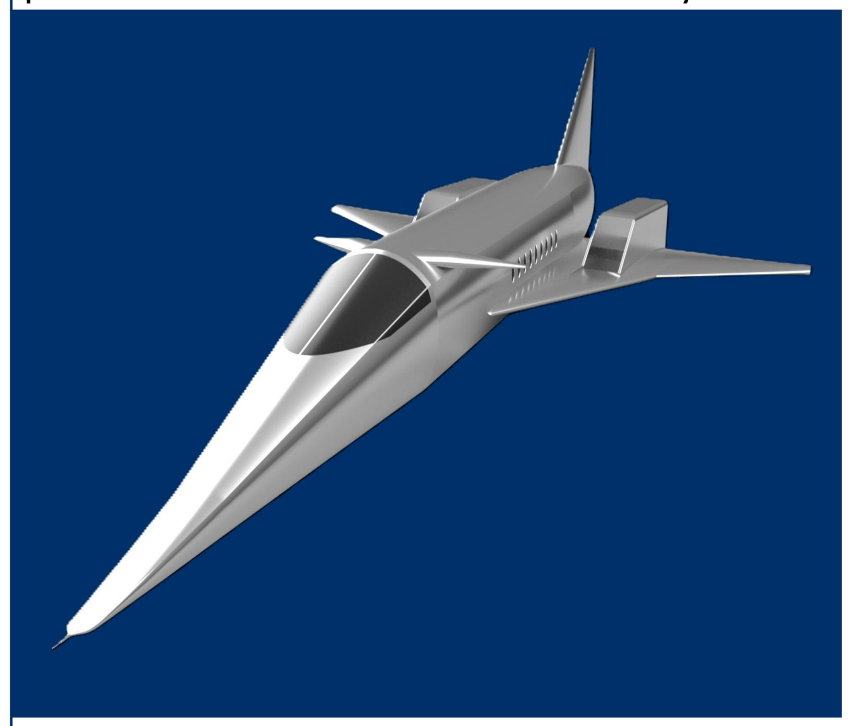
Background

Supersonic commercial aviation has historically demonstrated the potential to drastically reduce travel time, but it has struggled to achieve long-term profitability due to high fuel consumption, expensive ticket prices, and noise pollution particularly from sonic boom effects. As a result, there is a growing demand for alternative high-speed travel solutions that balance performance with economic viability.



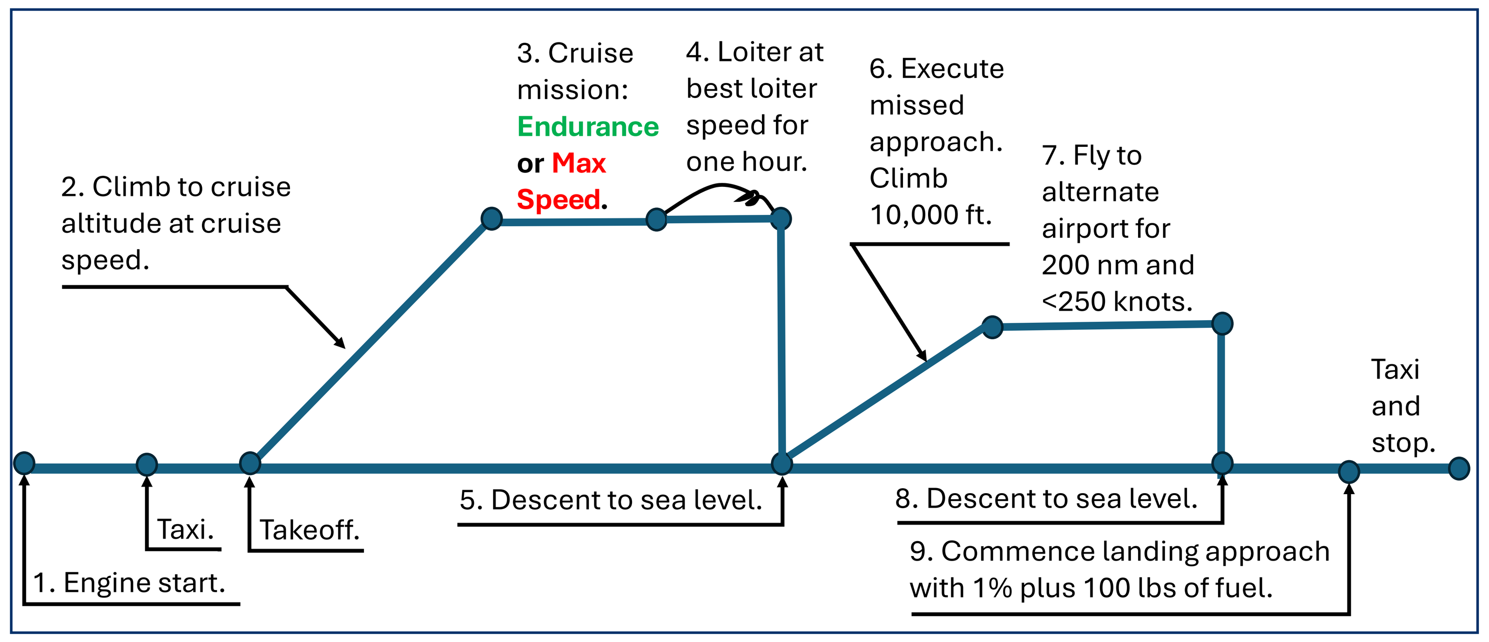
In today's market, business aviation offers a compelling opportunity to address this gap. Customers in this sector prioritize time efficiency, flexibility, and convenience, seeking to avoid the delays and constraints associated with commercial airline travel. A supersonic business jet (SSBJ) has the potential to meet these demands by significantly reducing travel time while operating within a more exclusive and adaptable framework.

The goal of this project is to develop a conceptual SSBJ that is both technically feasible and economically viable, ensuring that customers are willing to pay for the benefits of rapid transit. At the same time, the design must incorporate strategies to mitigate noise pollution, enabling overland supersonic flight and broader public acceptance. This aircraft, **Sleipnir**, is designed in accordance with 14 CFR Part 25 regulations, ensuring compliance with modern safety and performance standards.

Mission Requirement

Initial conditions	
Altitude (ft) Above sea level.	5000
Temperature (°F)	95

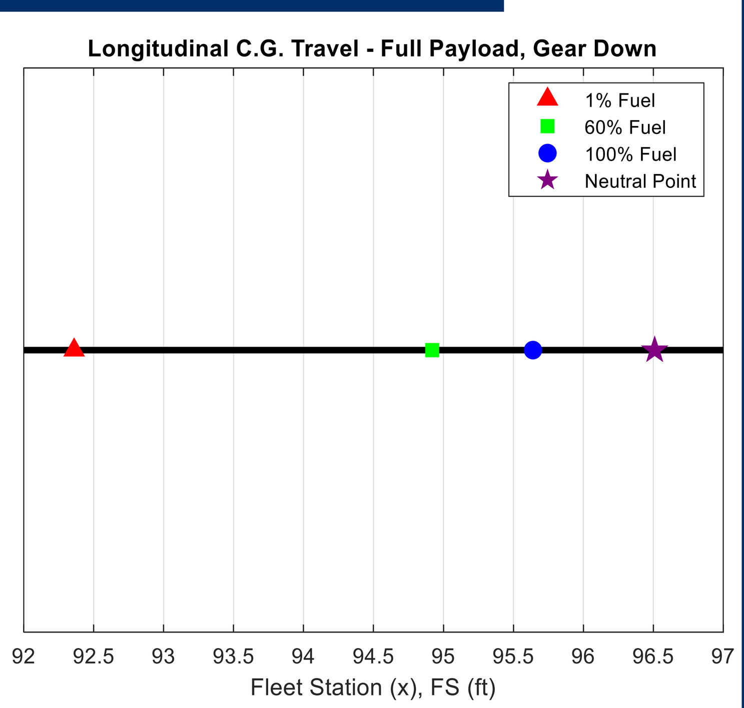
System Requirements	
# of passengers	10-19
Max speed (MACH)	2.0-2.2



Cruise Missions	
Endurance	Maintain optimum speed at optimum cruise altitude for 4000nm.
High Speed	Accelerated and maintain maximum speed at optimum cruise altitude for non specified distance.

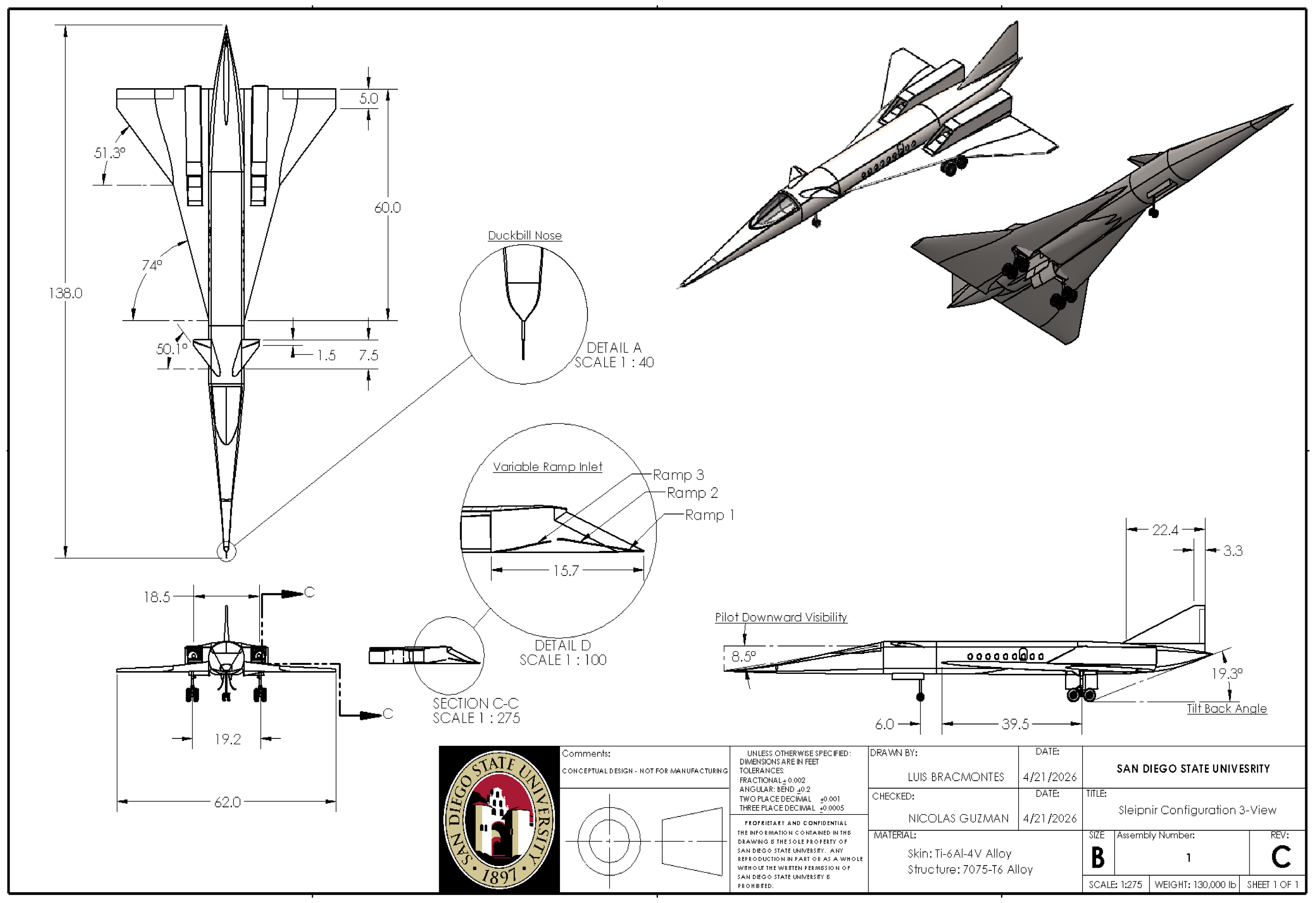
Weights and CG

Weight (lbs.)	
Operating Empty Weight (W_{OE})	56,000
Empty Weight (W_E)	54,700
Trapped Fuel and Oil (W_{tfo})	650
Crew Weight (W_{CREW})	690
Fuel (W_F)	71,200
W_{OE} + 60% Fuel	98,800
$W_{OE} + W_F$	127,000
Payload Weight (W_{PL})	2,500
Max Takeoff Weight ($W_{OE} + W_F + W_{PL}$)	**130,000**



The Sleipnir carries 10 passengers and 3 crew members. As the center of gravity shifts due to passengers moving and fuel burning, longitudinal stability is retained.

3 View Drawing



Design Choice

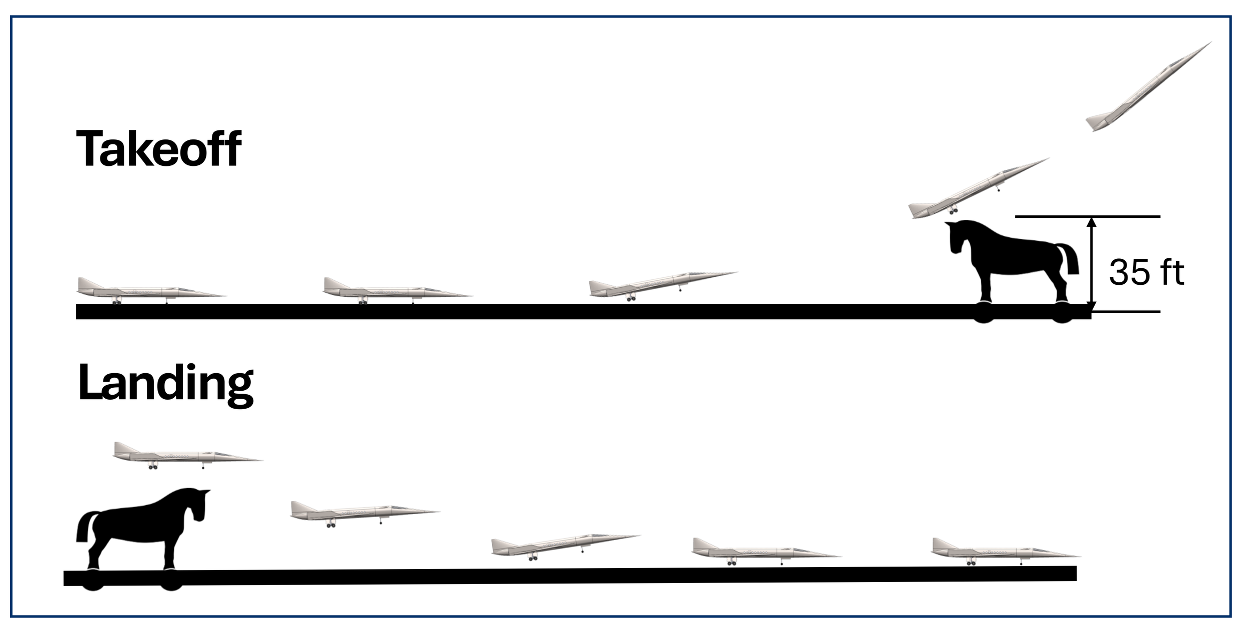
NOISE REDUCTION

Extending the nose and mounting the inlets above the main wing reduces shockwave strength and redirects it upward. A long, slender nose spreads pressure changes over a greater distance, weakening the oblique shock, while top-mounted inlets avoid the bow shock and draw in cleaner, smoother air. Together, these features improve pressure distribution and overall aerodynamic efficiency.

AERODYNAMIC EFFICENCY

A cranked delta wing and canard configuration improve aerodynamic efficiency, particularly at high speeds and high angles of attack. The cranked wing enhances high-speed lift while its outer sections aid low-speed maneuverability and promote stable vortex formation for sustained high-angle-of-attack flight. The canard adds lift and improves pitch control, reducing the need for large tail surfaces.

Takeoff and Landing Field Lengths



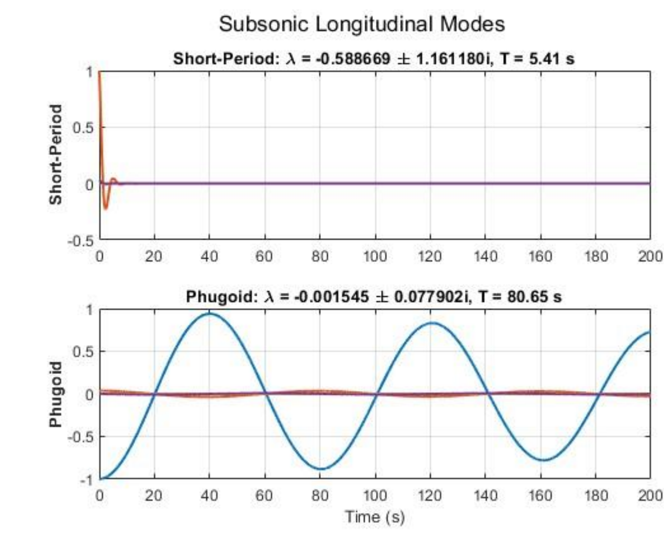
Major World Airports	Runway (ft)	Compatibility
Los Angeles International (LAX), USA	12,091	☑
John F. Kennedy (JFK), USA	14,511	☑
London Heathrow (LHR), UK	12,802	☑
Beijing Capital (PEK), China	12,467	☑
Singapore Changi (SIN), Singapore	13,123	☑

Takeoff	
Total required length (ft)	6400
Total time for take off (seconds)	44
Landing	
Total required length (ft)	9500

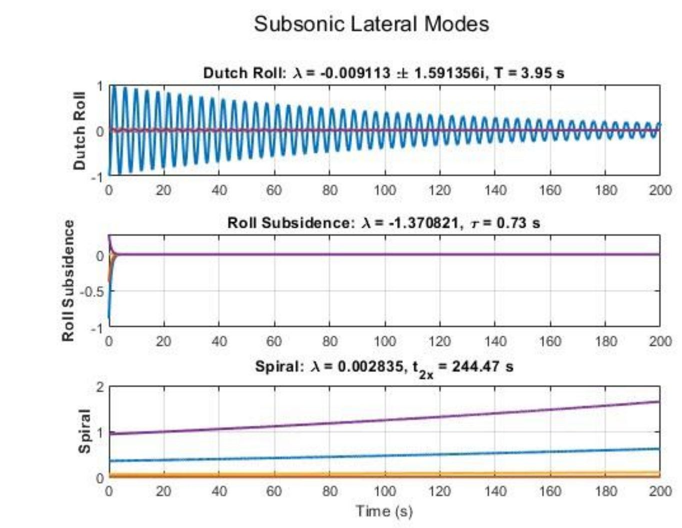
Performance

Cruise Conditions Subsonic
- Speed: 559 mph
- Mach: 0.847 @ 50,000ft
- Dynamic pressure (q): 0.845 psi
- Stagnation temperature: -13.8 °F
- Stagnation pressure: 2.689 psi

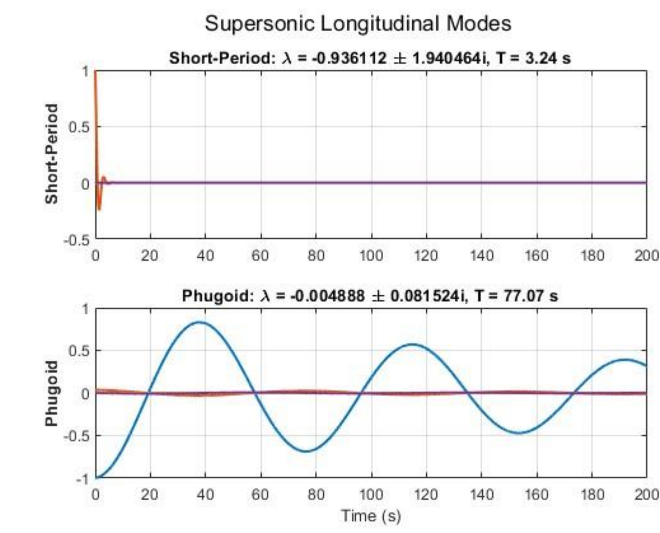
Cruise Conditions Supersonic
- Speed: 1452.1 mph
- Mach: 2.0 @ 50,000ft
- Dynamic pressure (q): 5.699 psi
- Stagnation temperature: 307.8 °F
- Stagnation pressure: 17.99 psi



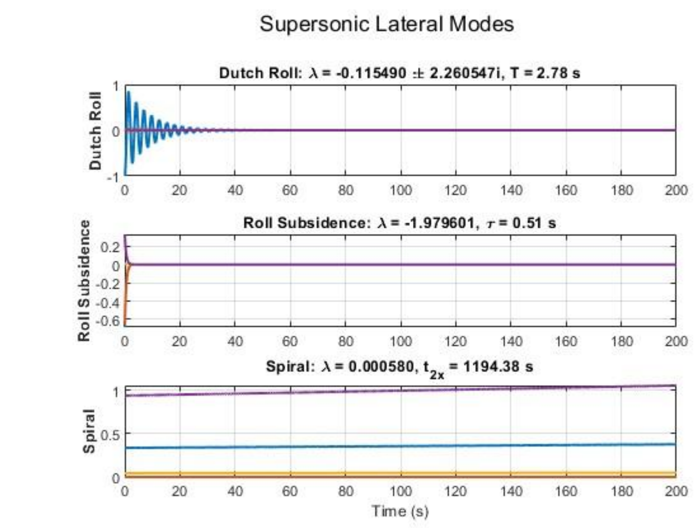
Caption: Subsonic longitudinal dynamics at Mach 0.85, highlighting a moderately damped short-period mode and a lightly damped phugoid with slightly longer period and lower frequency than in supersonic conditions.



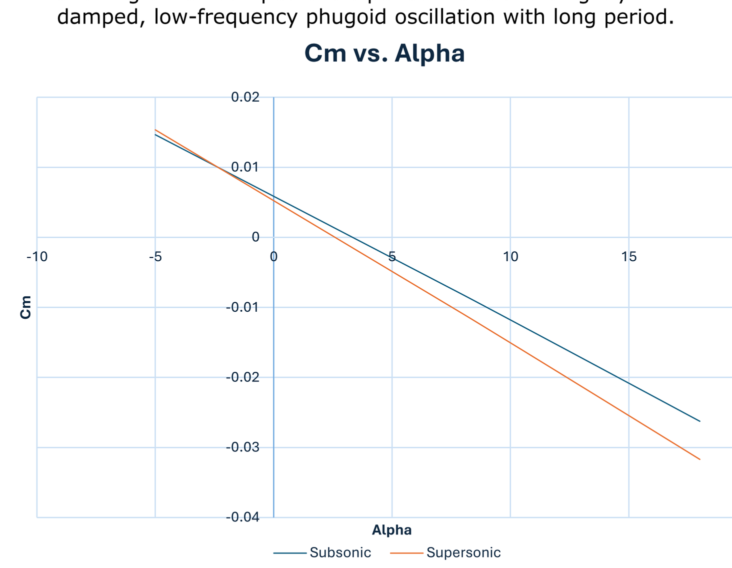
Caption: Time response of subsonic lateral-directional modes at Mach 0.85 and 50,000 ft, illustrating a lightly damped Dutch roll, fast roll subsidence, and a mildly unstable spiral mode with faster divergence compared to the supersonic case.



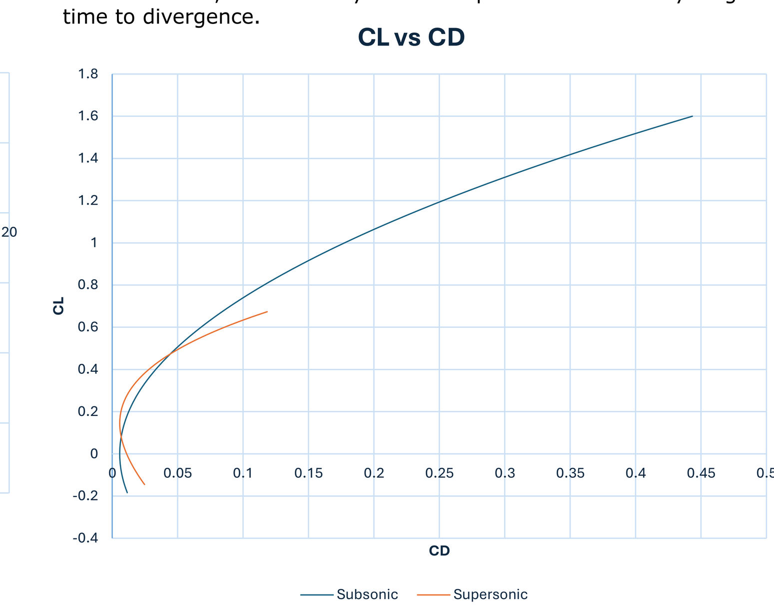
Caption: Supersonic longitudinal dynamics at Mach 2.0, showing a well-damped short-period mode and a lightly damped, low-frequency phugoid oscillation with long period.



Caption: Time response of supersonic lateral-directional modes at Mach 2.0 and 50,000 ft, showing a lightly damped Dutch roll, rapid roll subsidence, and a weakly unstable spiral mode with very long time to divergence.



Caption: Pitching moment coefficient versus angle of attack, comparing subsonic and supersonic regimes; both exhibit negative slope indicating static longitudinal stability, with supersonic flow showing increased stability (more negative slope).



Caption: Drag polar comparing subsonic and supersonic performance, showing higher drag penalties and reduced lift efficiency in the supersonic regime relative to subsonic conditions.

Cost

Cost	
Engines	$196,000,000.00
Avionics	$230,000,000.00
Manufacturing labor	$800,000,000.00
Material and equipment	$410,000,000.00
Sustaining engineering	$543,000,000.00
Tooling	$34,200,000,000.00
Quality control	$112,000,000.00
Total program cost	**$36,500,000,000.00**
Unit cost	**$390,000,000.00**
Unit price	**$450,000,000.00**

The Sleipner's $450M unit price is justified by its unique position as a supersonic, ultra-long-range business jet that delivers unmatched time savings, global mobility, and exclusivity. By significantly reducing the travel times it provides high-net-worth individuals and organizations with a strategic asset rather than a conventional transportation solution. The high development cost is driven by advanced aerodynamic design, regulatory compliance, and low production volume, making the price consistent with both market expectations and required program profitability.

Acknowledgements

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