Tail Stabilizer Design Efficiencies for Fighter Aircraft

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Problem Statement

Modern fighter aircraft must balance directional stability requirements with compact storage constraints on aircraft carriers. This creates a need to evaluate alternative tail configurations that maintain stability under One Engine Inoperative (OEI). Traditional tail configurations may limit design flexibility, making it necessary to evaluate alternative tail geometries that can maintain stability performance while improving compactness and efficiency.

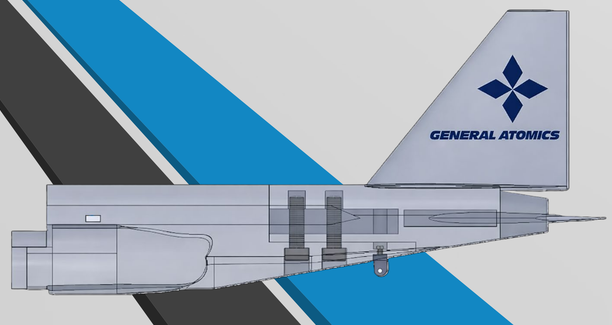
Background

- Fighter aircraft require strong directional stability conditions.
- Vertical stabilizers counteract yaw from asymmetric thrust.
- Conventional tail designs may limit compact storage and efficiency.
- Alternative configurations (V-tail, canted verticals) offer potential benefits but must be validated for stability.

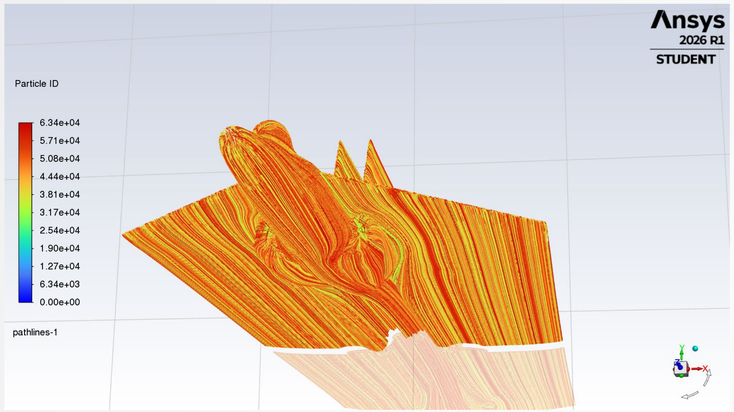
Objectives

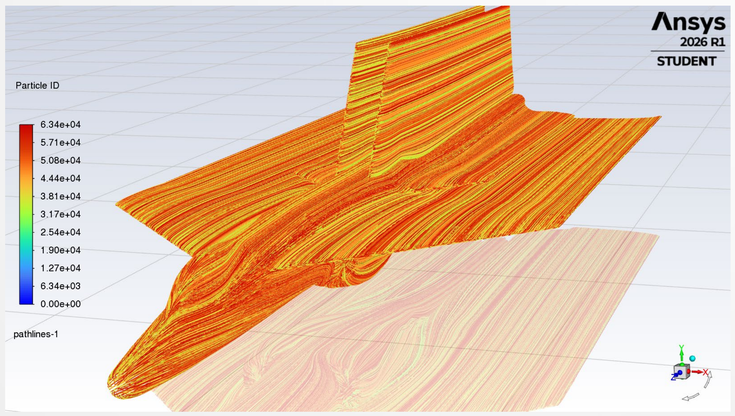
- Evaluate the directional stability of multiple tail configurations for fighter aircraft.
- Ensure all configurations meet One Engine Inoperative (OEI) stability requirements.
- Verify that each design meets the minimum vertical tail coefficient requirement ($C \geq 0.06$).
- Analyze the impact of vertical stabilizer design on overall aircraft stability.
- Compare alternative configurations (V-tail, canted verticals) to a baseline conventional tail.

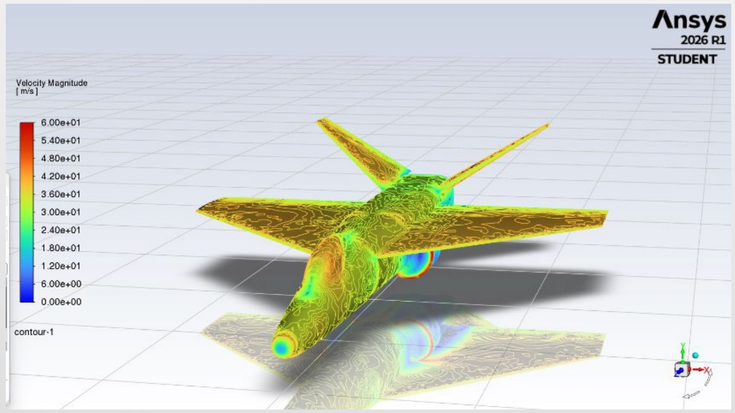
Design



Design & Analysis







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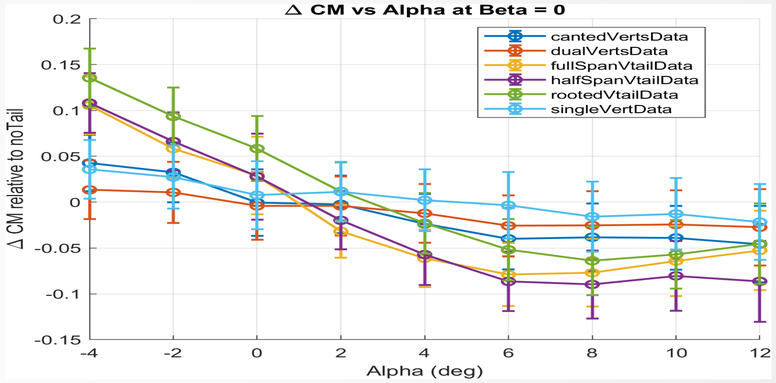
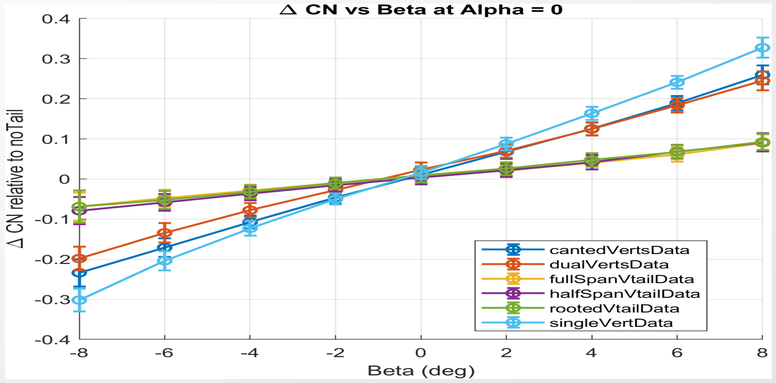
- **General Atomics:** Thank you for your donation to the Aerospace Engineering program in our name. We are excited to talk more about the project with you!

Results

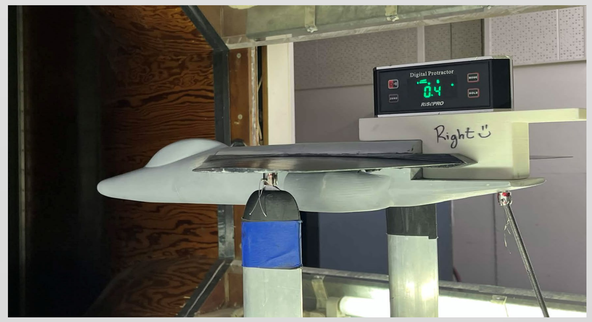


The ΔCM vs α and ΔCN vs β plots show that tail configuration strongly affects stability characteristics, with vertical tails providing superior directional stability and V-tail configurations enhancing longitudinal stability, highlighting a fundamental tradeoff in tail design.



Testing & Conclusion

Alternative tail configurations demonstrate feasible performance for fighter aircraft applications. A clear trade-off exists between directional stability and geometric compactness. Conventional tail configurations provide the highest stability margins, particularly under OEI conditions. Canted verticals and V-tails show potential to meet the minimum requirement ($C \geq 0.06$) while optimizing space efficiency. These results support the viability of non-traditional tail designs for carrier-based aircraft. Future work includes conducting analysis at higher flight speeds to capture compressibility effects and testing across a wider range of angles of attack and sideslip angles.



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