GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING
The UNIVERSITY *of* OKLAHOMA

Analysis of a Low-Cost Missile Option

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The Team



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Background

- There is an operational gap between low-speed low-cost UAVs and traditional cruise missiles
- Standoff weapons allow low-risk missions to be effective
- Wing-supported lift allows for greater mission versatility with options for low-speed maneuvering, loiter, and greater precision

Requirements & Constraints

- Design Points:
  - Mach number: 0.7, 0.8, 0.9
  - Altitude: 10 kft, 20 kft, 30 kft
- Range: 500 nautical mile
- Gross weight: 500 pounds
- Payload weight: 150 pounds
- Propulsion: Jet engine
- Maneuverability: +2 / -4 g
- Longitudinal static stability

Standards

- NATO STANAG 4671 - UAV certification
- MIL-STD-1797A - Fixed wing aircraft
- 14 CFR Part 33 - Propulsion certification

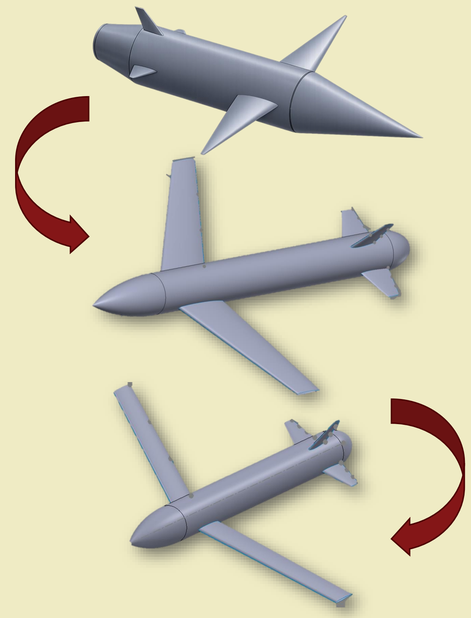
Impact

- Creates and evaluates a variety of designs to determine what trades can be made
- Enables effective strike missions with a much lower risk and cost than before
- Improved range and payload compared to other low-cost missiles

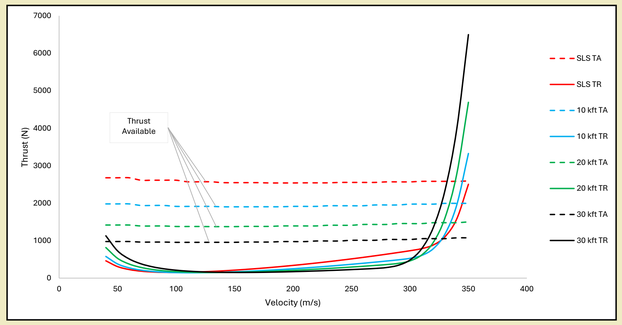
Design Process

- Initial design sized using methods from Raymer to meet constraints
- 24 additional designs evaluated analytically to determine decision effects on performance
- Critical characteristics scored using decision matrices
- Final designs underwent further evaluation including stability analysis using methods presented in DATCOM and structural sizing to verify maneuverability and weight requirements

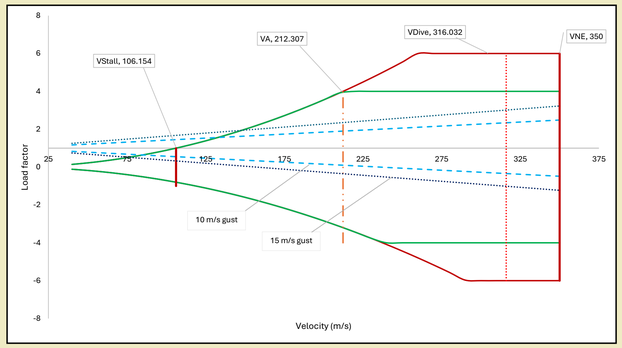
Design



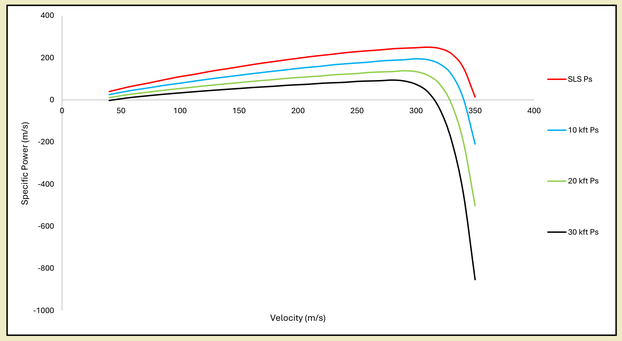
Design Data



Thrust and drag vs velocity at selected altitudes

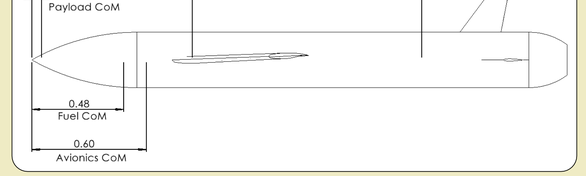


V-n diagram during cruise



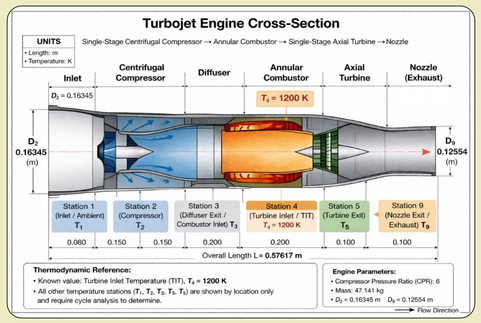
Specific excess power at selected altitudes

Layout



Engine Design

- Engine sized using typical non-isentropic cycle analysis
- Compressor pressure ratio: 6
- Turbine inlet temperature: 1200 K
- Max cruise thrust: 1.392 kN
- Max sea-level thrust: 2.889 kN
- TSFC: 2.855E-05 kg/(N.s)



Cost

- Airframe: $240,000 per unit
  - RAND DAPCA IV
- Engine: $126,000 per unit
  - RAND Turbojet Model
- Total: ~ $366,000 per unit

Recommendations

- 80% of mission at lower speed: M = 0.7, h = 30,000 ft
- 20% of mission for high-speed maneuvers: M = 0.9 to sea level
- Time of flight: 70 minutes