Advances in Hypersonic Missile Defeat Technology

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Problem Definition

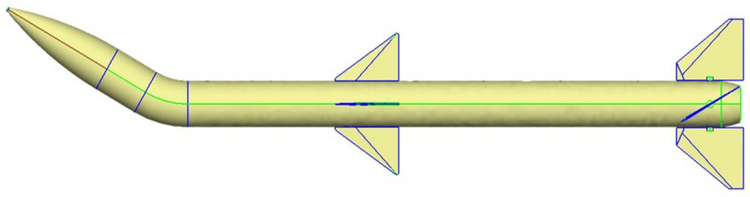
In this work, cadets and faculty at the US Air Force Academy are investigating technology that improves probability of kill against hypersonic threats. This includes the merits and means of active missile head articulation and improved warhead technology. This will provide a variety of benefits, like improvements in missile efficiency and maneuverability.

Stakeholders

Sponsors: Air Force Research Laboratory (AFRL), Aerospace Systems Directorate

End-Users: Air – to – Air Community

Consultants: Dr Rich Beblo, Dr Ben Dickinson



Morphing Missile Conceptual Design

Stakeholder Engagement

AFRL sponsors gave specific guidance on design requirements, to ensure parallel research with the prototype that AFRL is currently designing.

Design Requirements

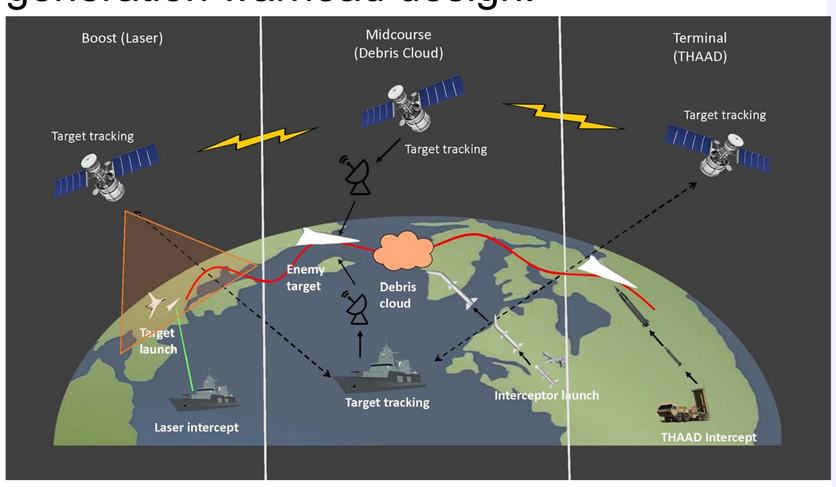
- **Next generation warhead:**
- Must fit AIM-120 volume and weight
- Increase P_k

- **Articulating Nose:**

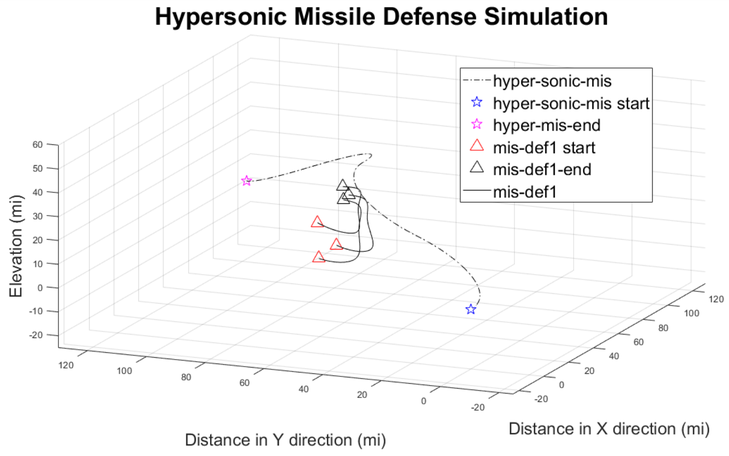
Requirements	Threshold	Objective
Articulation Rate	30 degrees/sec	60 degrees/sec
Moment	1,700 N-m	3,400 N-m
Articulation Angle	15 degrees	30 degrees
Roll Angle	0 degrees	-
Diameter	7 in	7 in
Length	10 in	7 in
Fit Test Rig Geometry	Yes	-

Next Gen Warhead Design

Cadets first investigated the best way to defeat an enemy hypersonic missile with a goal to develop technology that would increase probably of kill. An operational view (OV-1) was constructed of a mulit-tiered solution. Design work was focused on the midcourse defeat mechanism, more specifically on a next-generation warhead design.

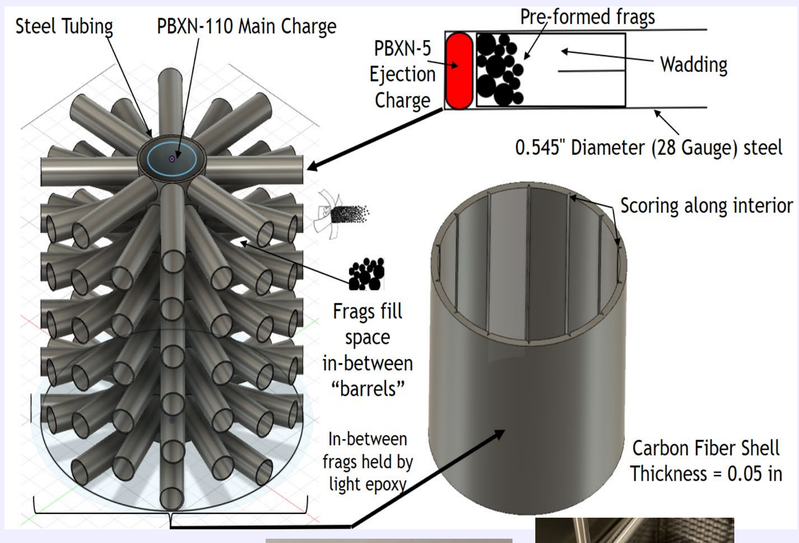


Hypersonic Missile Defense Simulation

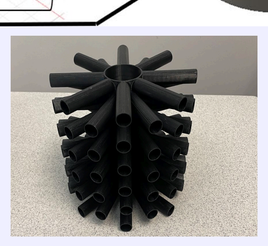


HyperMissile Defeat Warhead

Creates a large debris cloud to disrupt threat missile's thermal protective shield for aerodynamic loss-of-function

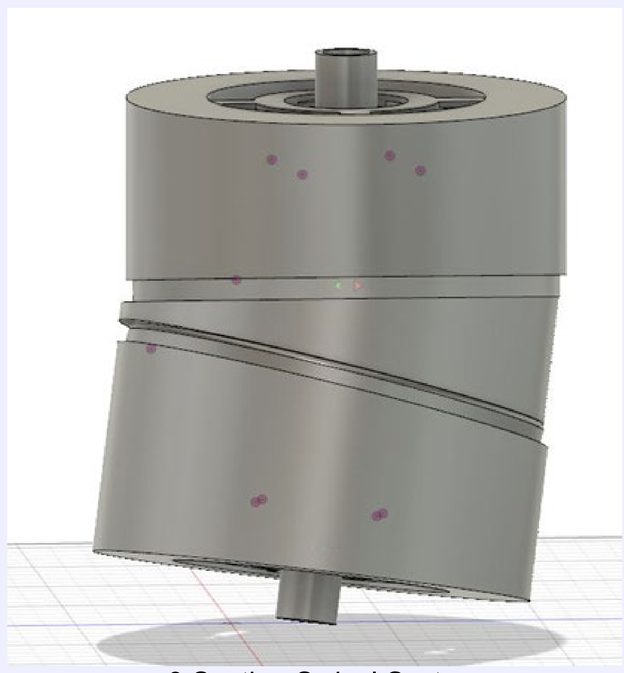


Prototypes



Proposed Solution: Missile Head Active Articulation

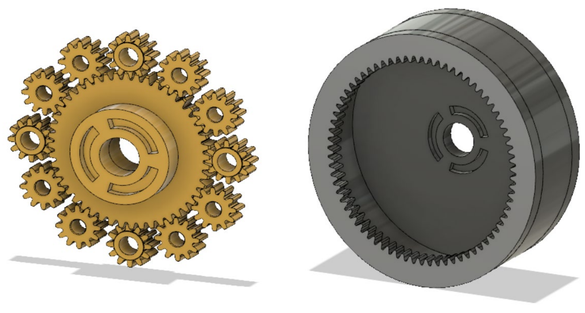
The concept the team is currently working on a multi-section swivel system that is driven by a single motor and drive shaft. This concept includes a clutch mechanism at each intersection that allows for actuation in a single degree of freedom a high rate of speed.



3 Section Swivel System

Focus Areas for AY21-22

1. Design a motor system that meets the outlined requirements, ideally from COTS available parts.
2. Design a drive shaft system that meets the outlined requirements.
3. Minimize losses in gearing to maximize motor efficiency.
4. Prototype design that is compatible with AFRL test rig geometry.



Planetary Gear System with Strain Wave Gear Interface

Acknowledgements

We would like to thank DFME for the instruction and support in our endeavors, AFRL for sponsoring the project, and the members of the mechanical engineering lab for their assistance and devoted support.