# SMART FINS: EXPERIMENTAL VALIDATION OF ACTIVE CANTILEVERED BEAM

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## MOTIVATION AND OBJECTIVES

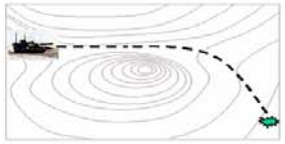
Piezoelectric actuation can be used for steering and control of Fins and Canards of projectiles. Analytical/Computational tools, which relates the resisting torque versus the angle of attack have been developed.

The angle of attack of the fin is related to the angle of twist of two(2) parallel cantilevered beams, which are also related to their transverse displacements at the tips. Therefore, there is the need to correlate the experimental data generated and the analytical/computational results.

The objective of this research is to measure parameters such as transverse displacement and strain at various locations on the fin. The parameters can be correlated with the predicted results from analysis and FEM (ANSYS).

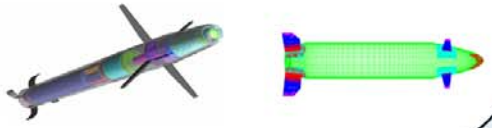
## BACKGROUND

Theoretical Trajectory for Projectile



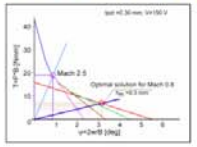
Steering & Control of Fins & Canards for Projectiles

Aerodynamic Analysis Showing the Stress on Fins & Canards. This gives the Torque vs. Angle of Attack Curves.



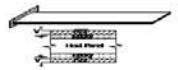
## BACKGROUND

A Typical Torque vs. Angle of Attack Curve



Fin Deflection Using Two Piezo-Activated Cantilevered Beams

Piezo-Activated Cantilevered Beam



## PROCEDURE

Material System: PZT, Thin film adhesive, glass/epoxy.

Laminate: 5-Layered Active Structure

Experimental Parameters:

1. Thickness of the host panel
2. Applied voltage
3. Piezoelectric strain coefficient
4. Thickness of the adhesive layer
5. Elastic modulus
6. Thickness of PZT

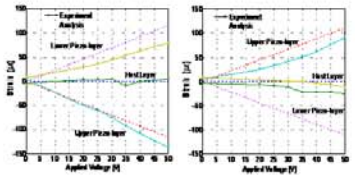
Diagram of the Cantilevered Beam used:

## EXPERIMENTAL VALIDATION OF ANALYTICAL/COMPUTATION TOOLS

Loading:

1. Electrical field
2. Mechanical load
3. Combined electrical field and mechanical load

## RESULTS



Experimental and analytical strain versus applied voltage curves
E = 2,250,000psi, (a) Upward deflections, (b) Downwards deflections

## CONCLUSIONS:

Strain values on the beams were recorded, using data acquisition systems. Transverse displacements were also recorded using a laser.
The results are correlated with analytical predictions, and good agreement was found.

The correlation of the displacements is ongoing.
The correlation with FEM, using ANSYS, is also ongoing.

The significance of the research is the development of experimental tools needed to compliment both analytical and computational tools required to build smart fins, which are designed to resist the aerodynamic loads of flight.

## ACKNOWLEDGEMENTS:

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