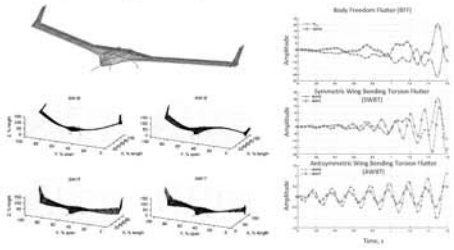
National Aeronautics and Space Administration

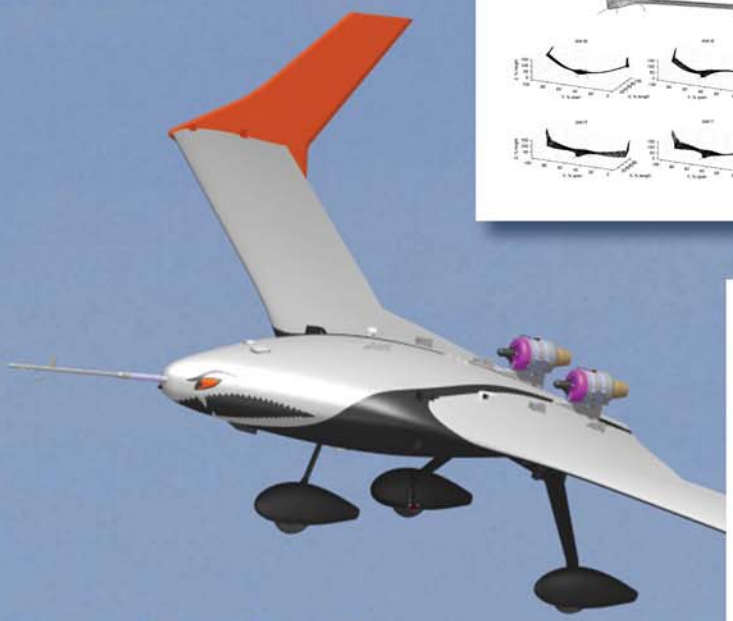
# Beyond Rigid Body

## Breaking the Flutter Barrier with Fiber Optic Sensors

### The Problem

- The X-56A aircraft was designed intentionally with flutter modes in its flight envelope
  - Normal modes couple with rigid body motion in flight at certain speeds leading to instability





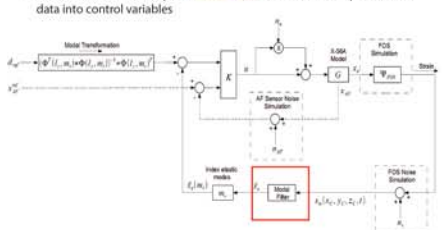
### The Solution

X-56A and Fiber Optic Sensors

- One of the key missions of the X-56A program is to demonstrate advanced sensing and its use in control systems
  - A great accomplishment would be to demonstrate them in active flutter suppression and shape control of a flight vehicle
- High resolution sensors under investigation include fiber optic sensors
  - Simultaneously report 1,000s of strain measurements at small intervals along a fiber

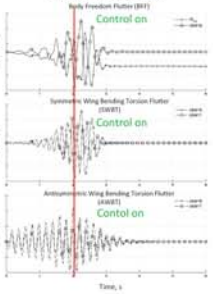

### The Results

- A control architecture was developed to use fiber optic sensors to control the shape of the aircraft
- Simulation architecture converts a desired wing deformation shape into a command the control system can achieve
- Makes use of the least squares modal filter to convert fiber optic sensors data into control variables

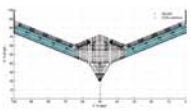


- In simulation demonstrated Active Flutter Suppression on X-56A models with simulated strain feedback from thousands of sensors
- Results demonstrated the impact of using fiber optics and control surfaces to suppress flutter

X-56A - Active Flutter Suppression Simulation using FOSS




FOSS Mapping (6 fibers)



# X-56A

## Multi-Utility Aeroelastic Demonstrator