X-56A Research Opportunities

Lockheed Martin visit to NASA Dryden
August 2012

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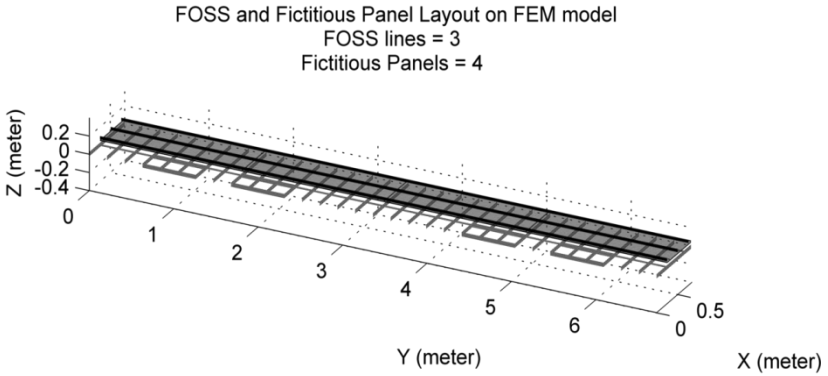
X-56A Multi-Utility Technology Testbed (MUTT)

- **NASA research interests**
  - **Develop robustness criteria for active structural control**
  - **Integrate emerging sensor technology (i.e. FOSS, LESP)**
  - **Use MDAO and flight measurements to improve aeroservoelastic modeling and analysis**
  - **Publish and distribute open source flight-validated realistic aeroelastic models for academia and industry use**
  - **Develop future research experiments (i.e. distributed conformal trailing edge flap control)**

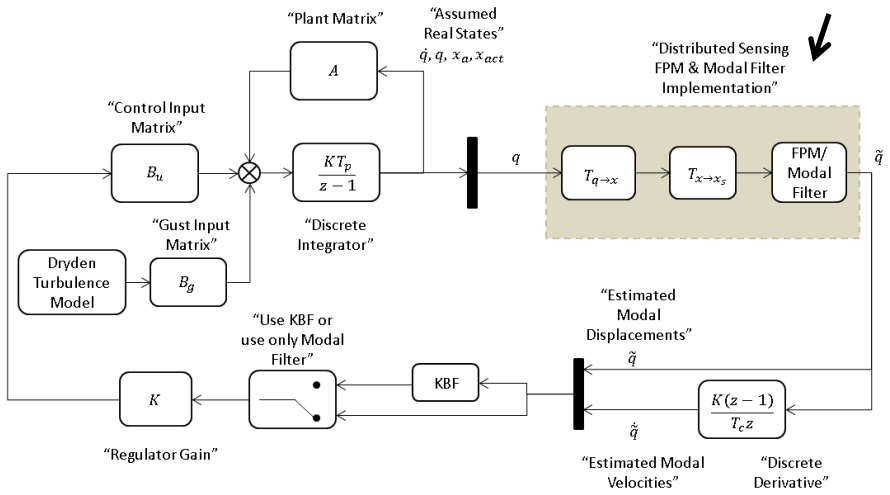
Aeroelastic Control using FOSS

Generic Aluminum Wing Geometry

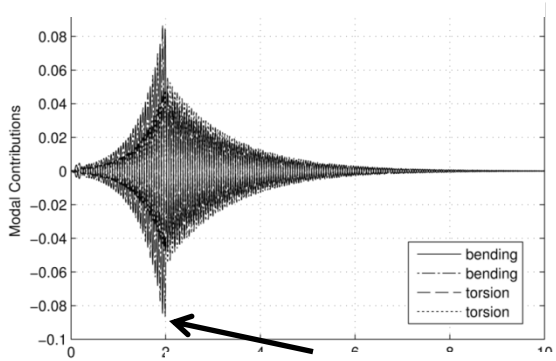


Simulation Model for FPM Based Modal Filtering

Simulated FOSS



- **Using an analytic model simulate measurements from a Fiber Optic Strain Sensing (FOSS) system**
- **Investigate different control strategies to develop methods to best utilize this information for enhanced flight control**



Suppression On

X-56A Research Opportunities, August 2012

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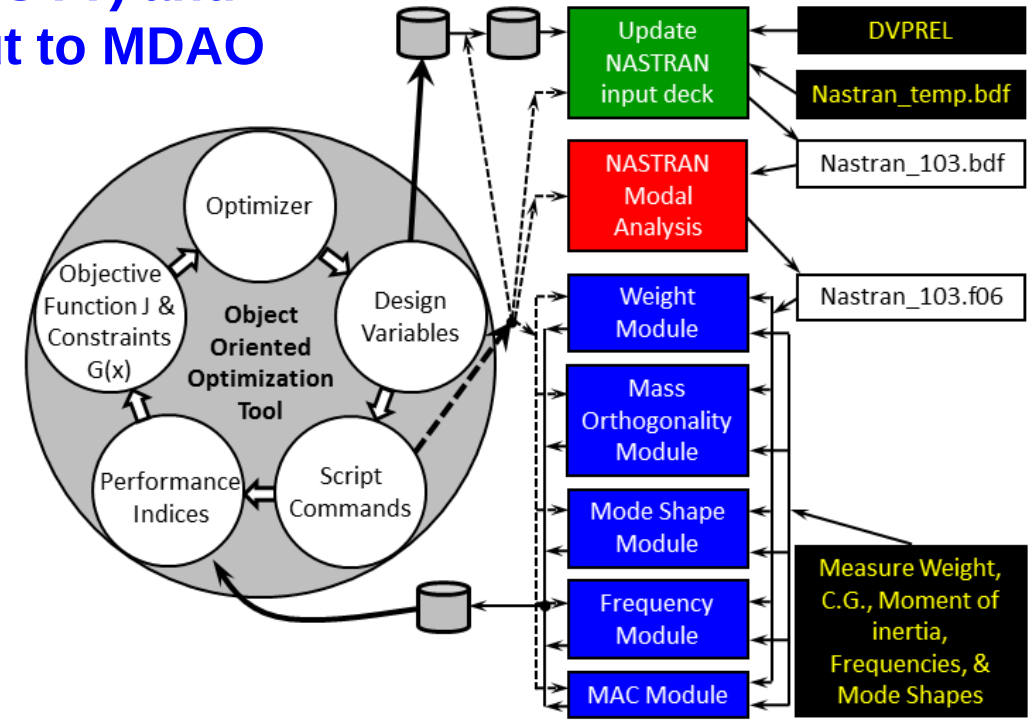
Structural Dynamic Model Tuning using Object Oriented Optimization Tool

- Ground Vibration Test (GVT) and flight data used as input to MDAO tool
- Vary model parameters to match test-measured characteristics
- Lessons learned provide model improvement for future designs
- Validated models published for research community



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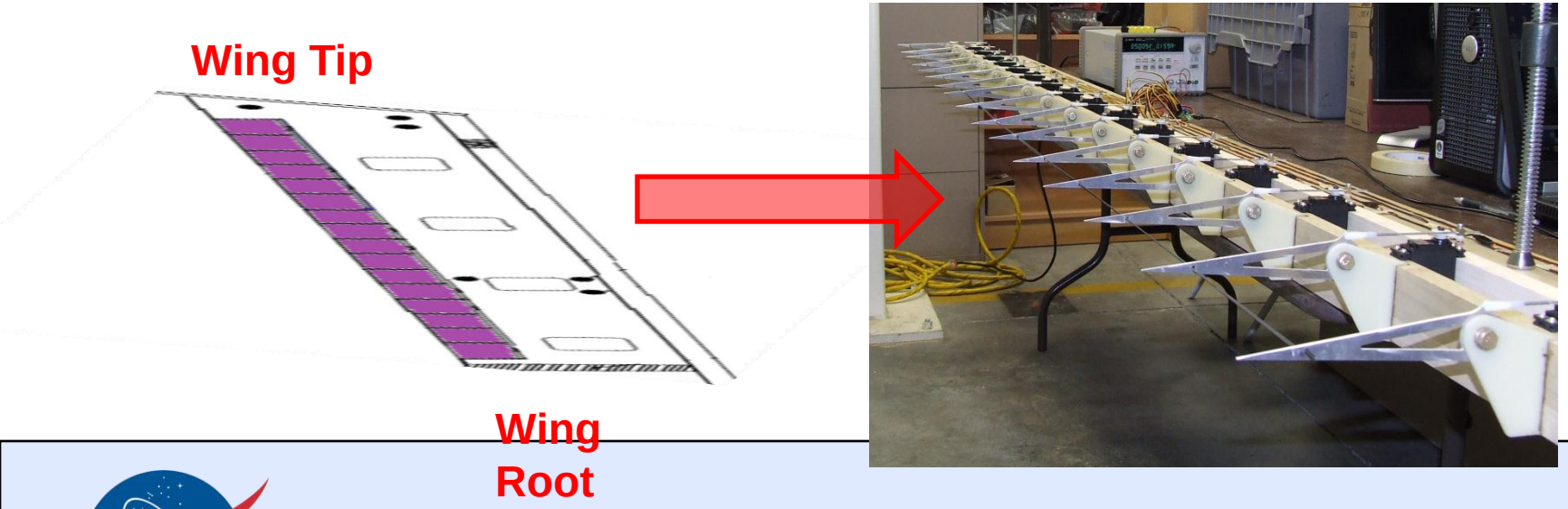
Distributed Conformal TEF Surface Control

- Developed bench model to demonstrate concepts
  - Model built based on X-56A control surface dimensions
  - 16 independently actuated control surface ribs
- Optimal Control Allocation (OCA) can approximately mimic the constraints imposed by a constrained smoothing spline
  - Emulate and enforce boundary and adjacent surface constraints in software



Other Work using X-56A as Sample Case

- Active/adaptive flexible motion control with aeroservoelastic system uncertainty
  - Add control delta based on difference between model predicted and output response measurement
- Unsteady Aerodynamic model tuning using object oriented optimization tool
- CFD-based flutter analysis
  - Using a known structural model (FEM) and unsteady CFD, use an iterative process to determine the critical dynamic pressure (flutter boundary)

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To Fly What Others Imagine …