



Real-Time Operating Deflection Shapes Display



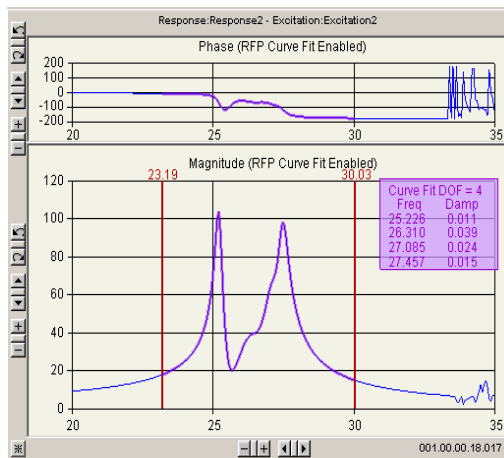
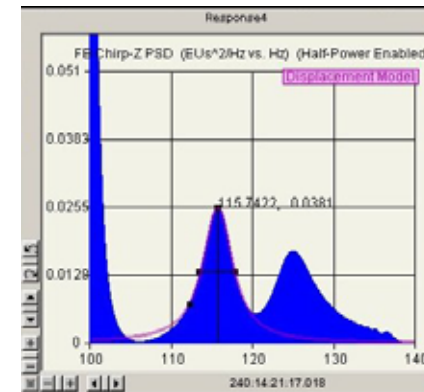
Real-Time Operating Deflection Shapes Display



Existing Frequency Domain Analysis

- **Modal Analysis**

- Half Power Damping (SDOF)
- RFP Curve Fit in Real-Time (MDOF)
- Excellent Mathematical Results



- **One Location at a Time**

- Does not Summarize
- Must Rely on Post-Test Processing to Visualize Structure's Behavior



Effective Data Displays Use Motion

- IADS displays use real-time parameters to move control surfaces on aircraft models for situational awareness.
- Motion is easier to interpret than alphanumeric in a real-time flight test environment.
- Motion in displays is the often key to event recognition.



Animation of Mode Shapes

- Most post-test analysis software packages animate mode shapes at a user-chosen frequency.
- Very useful technique for visualizing motion.
- Intuitive evaluation of how a structure moves.
- Mode shape animation often based on results of global curve fit.
- Global curve fit difficult to do in real-time at present.

Soon...



Animation of Operating Deflection Shapes

- Does not require a global curve fit.
- Can be performed directly from FRF or response-only frequency domain data.
- ODS near Resonance \approx Mode Shape.
- ODS is a widely accepted analysis tool.
- IADS already has most of the components required to animate ODS.

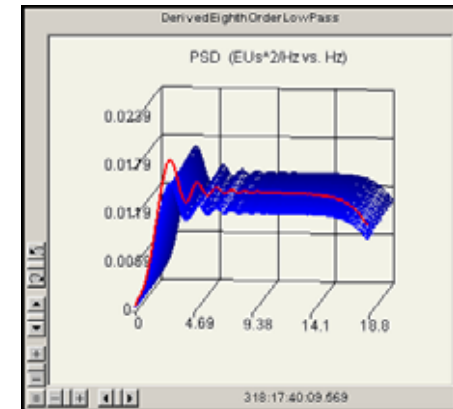
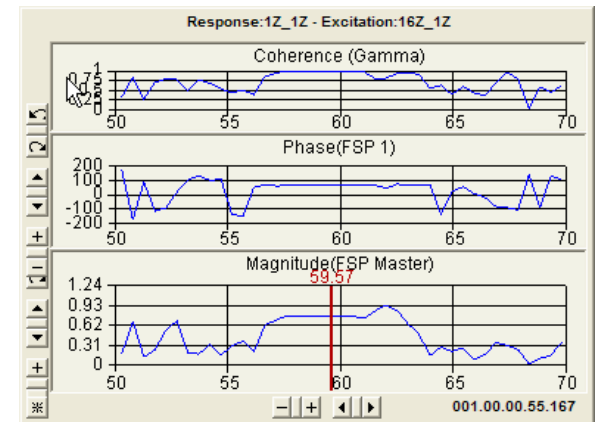


Existing IADS Components

- Frequency Response Plots
 - Provide Phase and Magnitude at Frequency
- PSD/Auto Spectrum Plots
 - may contribute to ODS-FRF Displays
- 3D ActiveX Aircraft Models
 - Provide the Visual Reference and Vector Animation

IADS Frequency Domain Displays

- **Frequency Response Plots**
 - Windowing, Overlap, Averaging Allows an Entire Sweep to be Processed
 - Internal Cross Spectrum Calculation
 - Chirp Z transform
 - Provides Phase and Magnitude needed for ODS
 - Coherence Option Adds Confidence
- **Frequency Plots**
 - PSD, Auto Spectrum Provide Magnitude needed for ODS
 - Phase can be obtained by borrowing Cross Spectrum from FRP
 - Allows ODS with Ambient Excitation

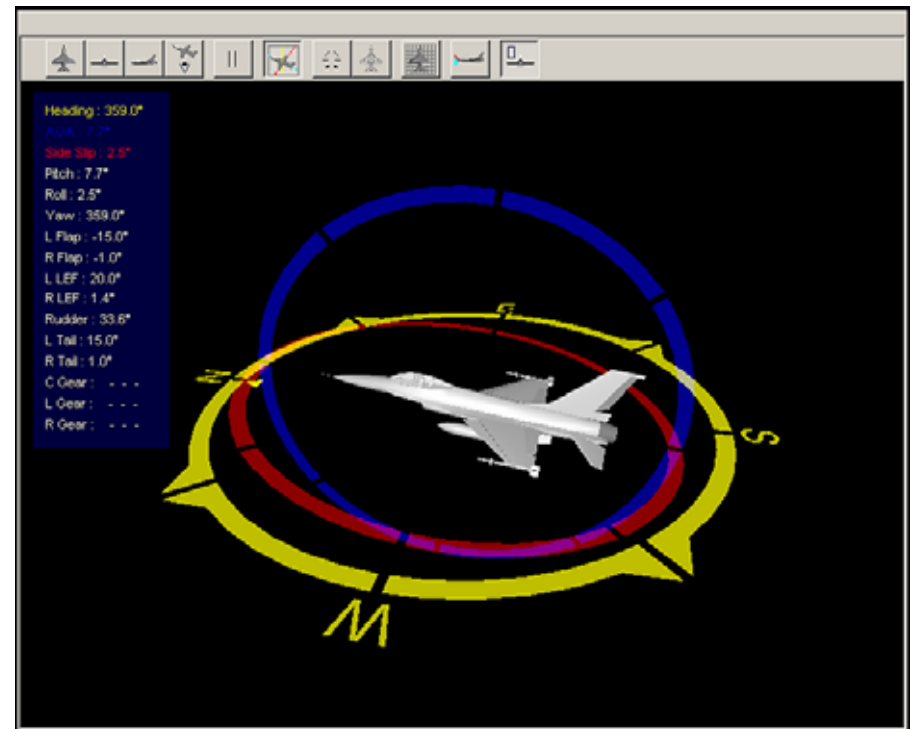


Aircraft Model Displays

- **ActiveX Control Models** - Various 3D aircraft models already exist in IADS and can easily be enhanced to animate Operating Deflection Shapes.

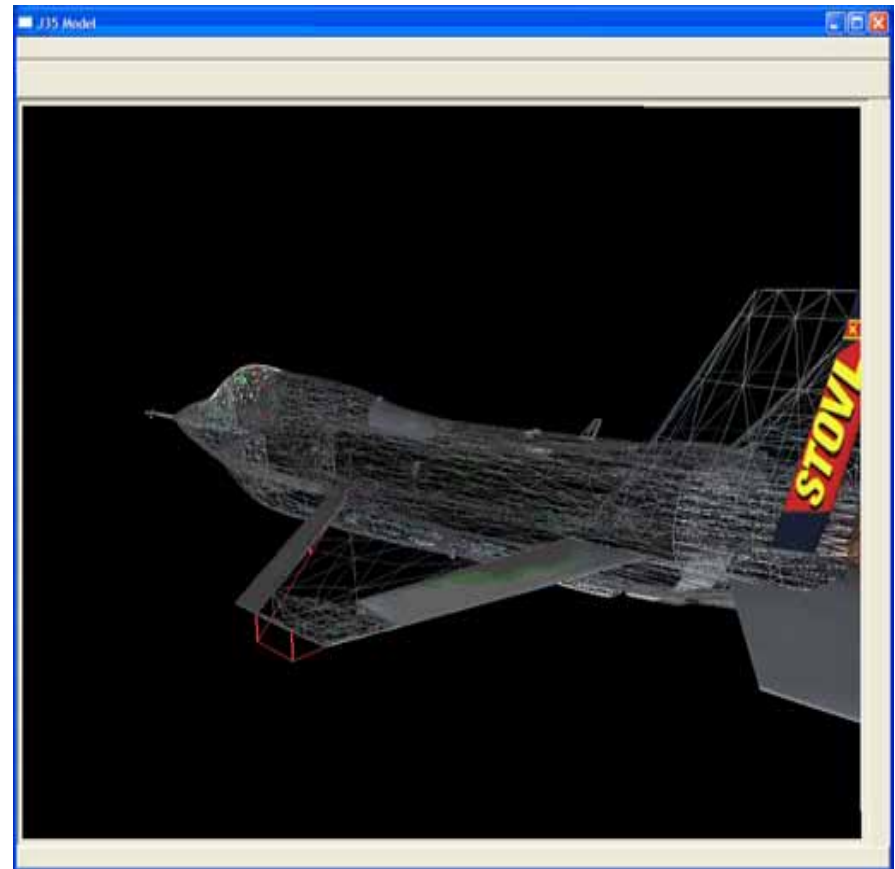
- **Display Flexibility** - Superimpose vectors to animate ODS on any surface in real-time.

- **COM Interface** – Facilitates real-time data sharing between different display objects.



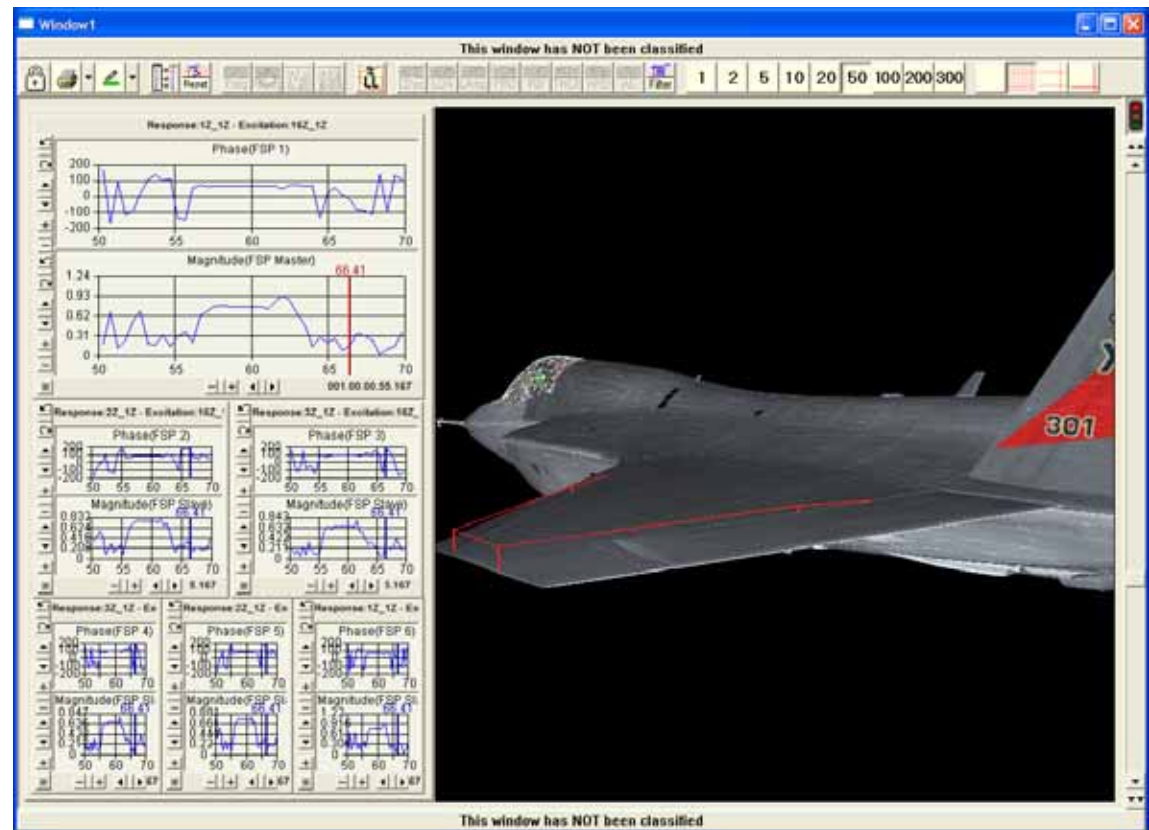
Summarize FRF Data Into One Display

- User Selects a Frequency.
- Phase and Magnitude Data is Collected from FRF's.
- Animation Commences...
- Immediate Visual Results!



Typical IADS ODS Analysis Window

- Master FRF On Top with Red Frequency Selection Bar
- Slave FRF's Below Master with Frequency Indicators
- Airplane Model with Red Lines Indicating Deflection





IADS ODS Future Directions

- Proof of Concept Only...
- Explore ODS-FRF Technology to Animate using only Measured Response Data.
- Make Accelerometer Positioning Easier for Users. Mouse Clicks?
- Enhance Operation to Full 3D Motion.
- Truly Animate the Model.



Contact Information

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Aerospace Testing Expo 2006, Hamburg Germany

Commercially available product. Numerous contracting options are available
to procure IADS, including GSA contracting vehicles.

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