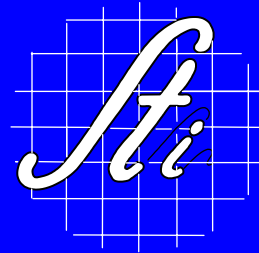


CURRENT ACTIVITIES AT SYSTEMS TECHNOLOGY, INC.



David H. Klyde
dklyde@systemstech.com

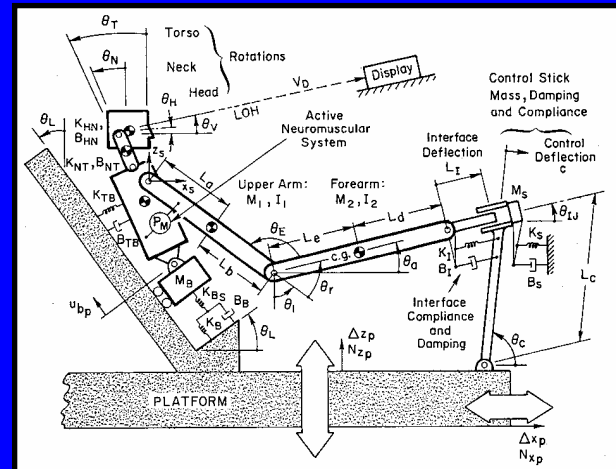
SAE Aerospace Control & Guidance Systems Committee
Meeting No. 95

Salt Lake City, UT
2-4 March 2005

BIODYNAMIC MODEL VALIDATION

- Ongoing work for ARL as part of a Phase II SBIR
- A fully nonlinear, multi-body version of STI's BIODYN has been created using the Tango software package
- Data collected by U. of Michigan on TACOM Ride Motion Simulator (RMS) is being used to validate the model
- Primary data is in the form of x,y,z captured motions of markers located on key subject and platform landmarks

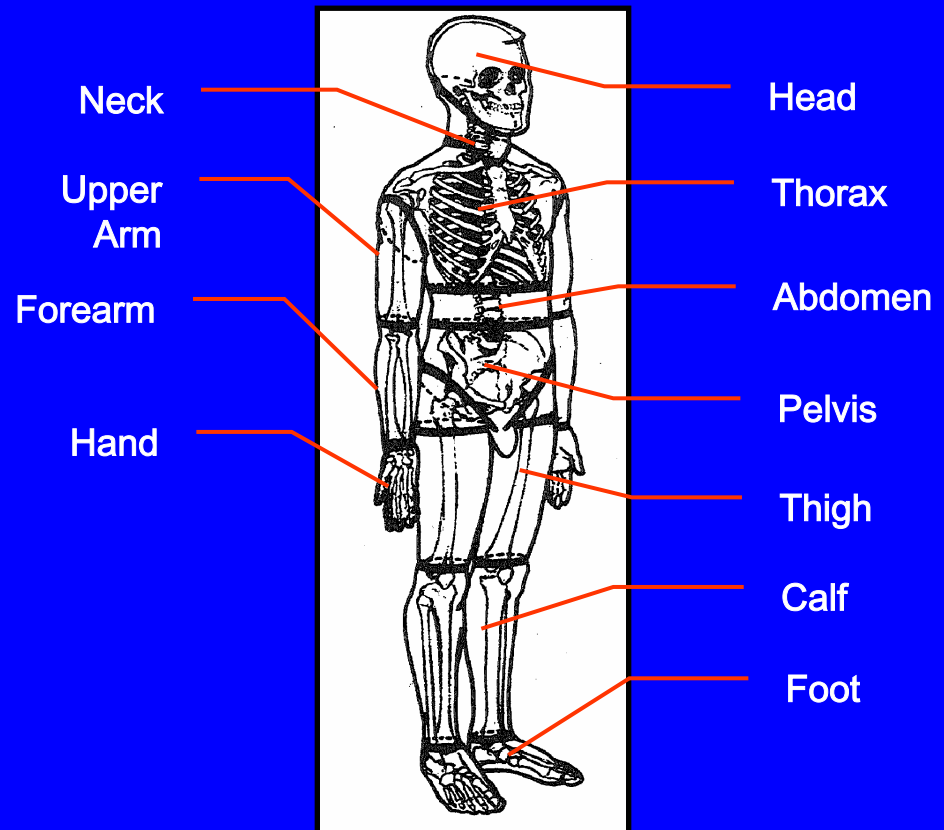
Original STI BIODYN Model



TACOM RMS Setup

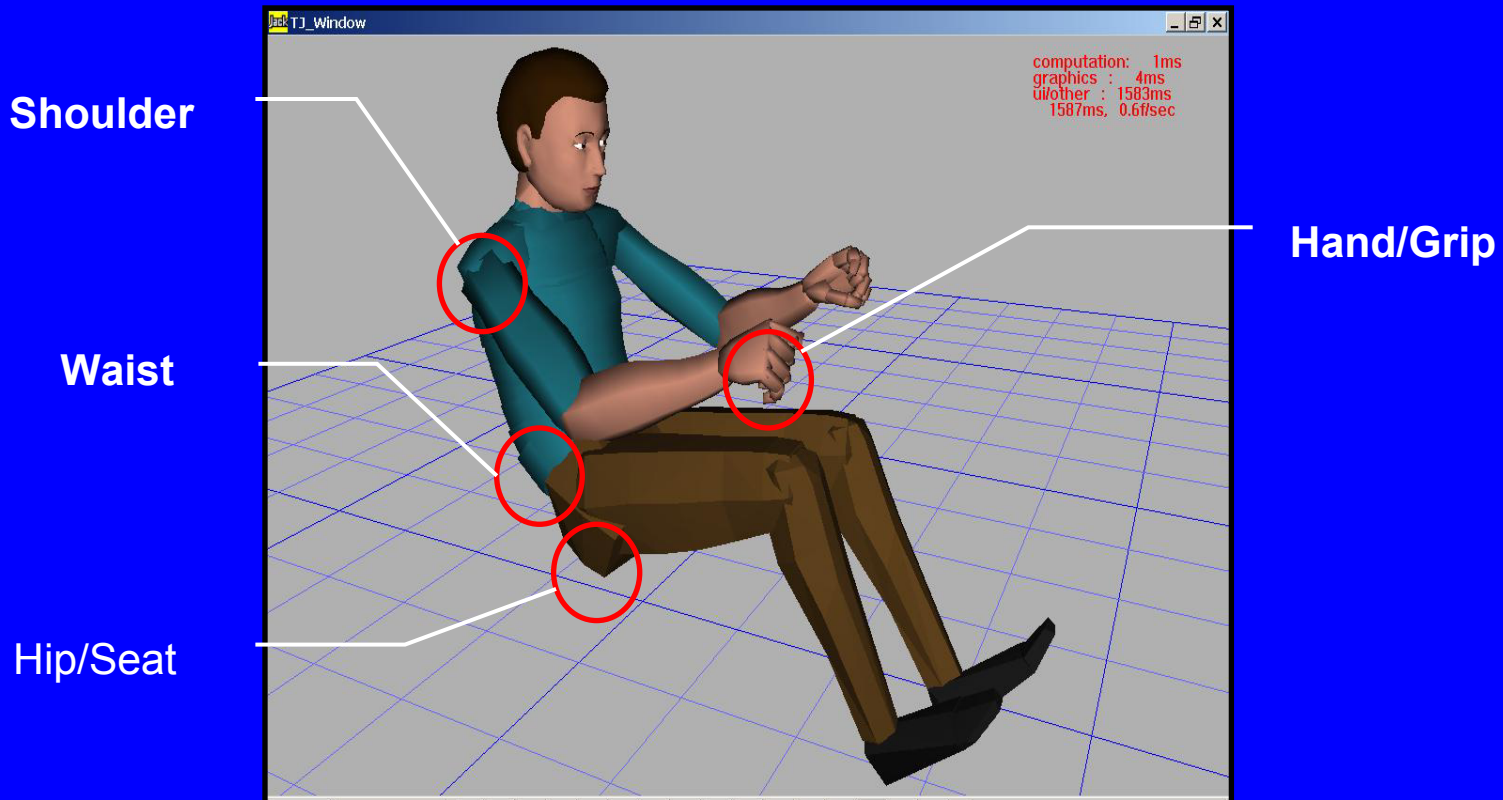
BIODYN MODEL SETUP PROCEEDURE

- Setup workstation and posture using anthropometric software package (in this case *Jack* by UGS PLM Solutions)
- Use USAF GEBOD software (developed by Systems Research Laboratory, Inc.) to compute body segment mass and inertia properties
- Neuromuscular system parameters identified from RMS data



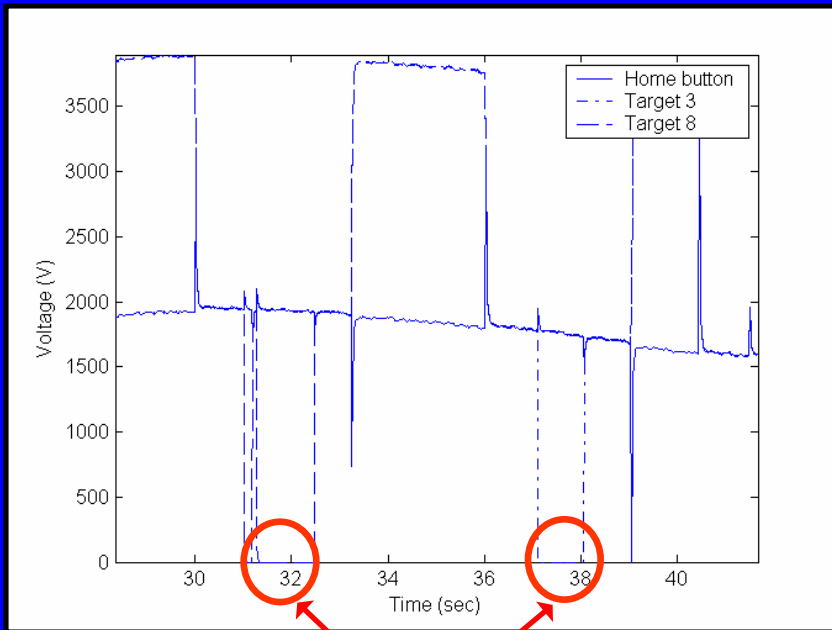
GEBOD Body Segmentation

DRIVING POSTURE ELEMENTS THAT IMPACT BIODYNAMIC RESPONSE

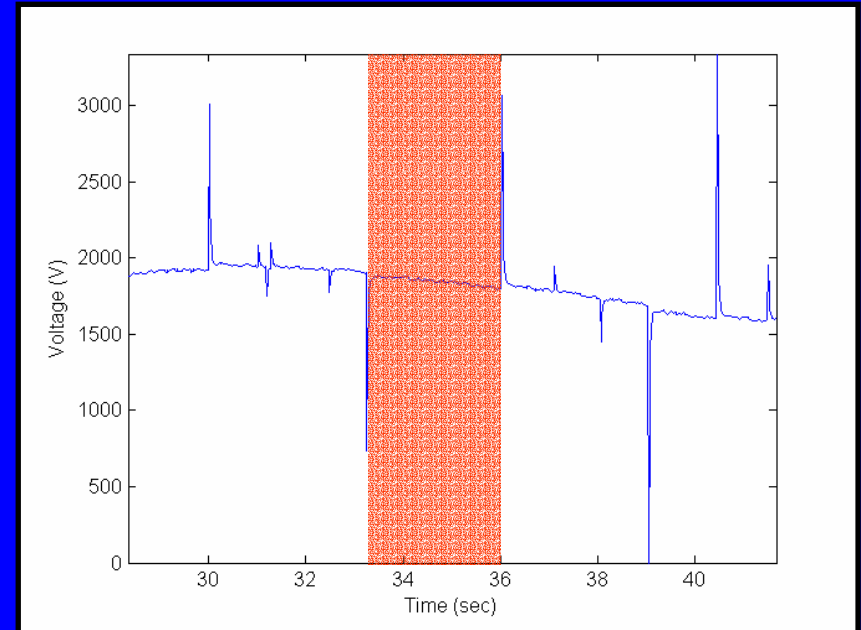


Manikin created in Jack

SELECTION OF DATA SEGMENTS FOR ANALYSIS



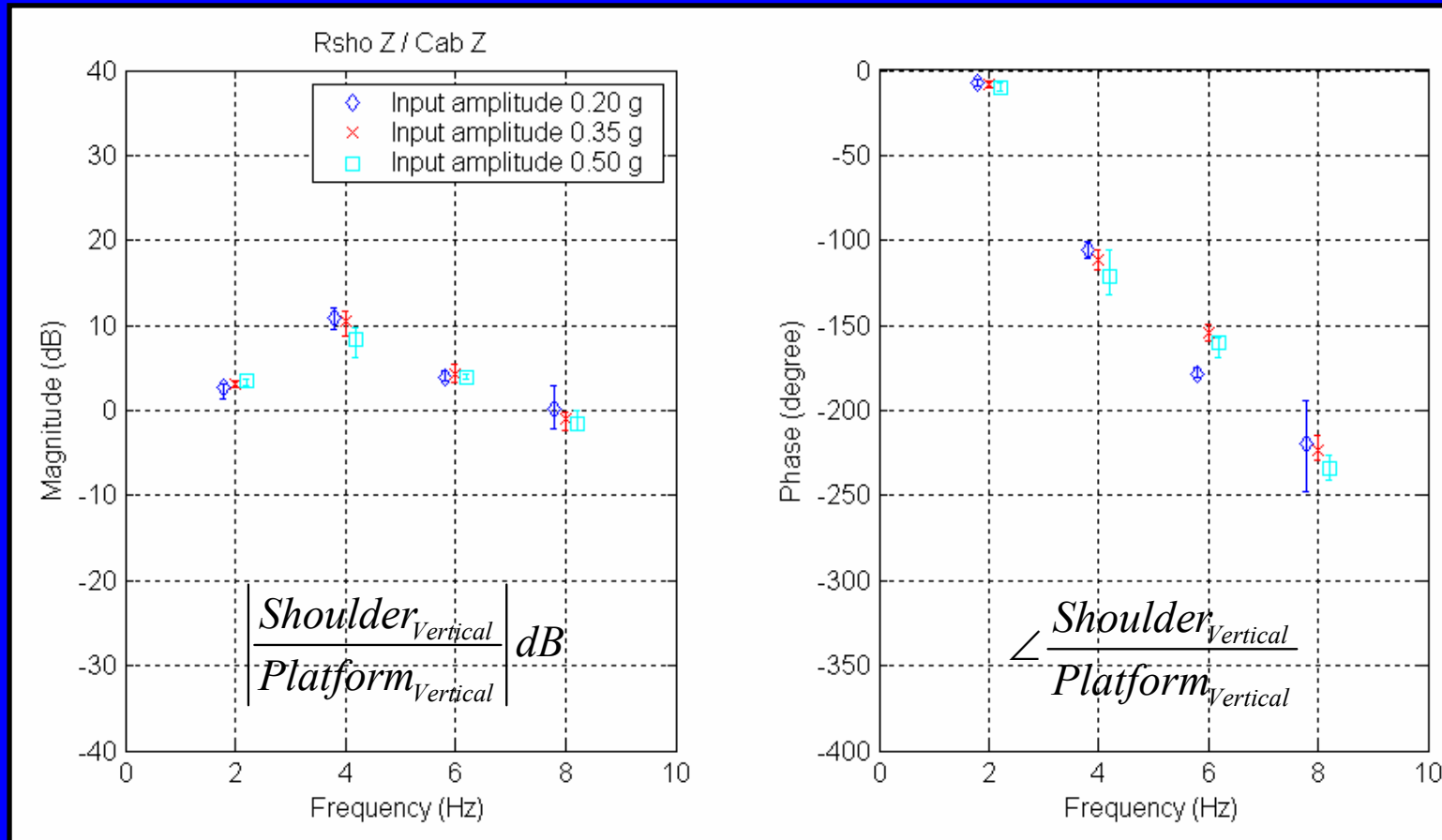
Target Buttons Engaged



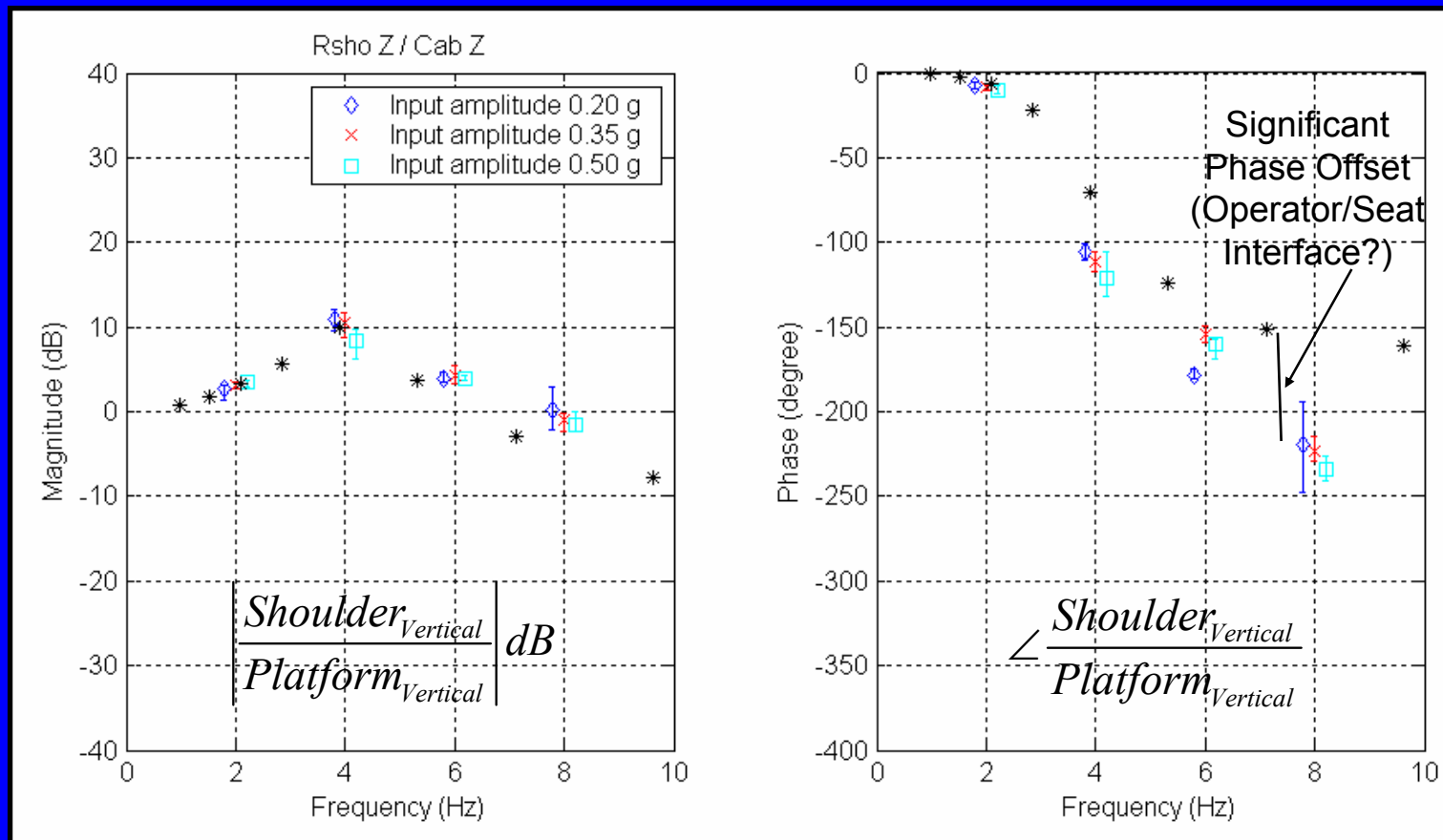
Subject in Driving Position

EXAMPLE FREQUENCY RESPONSE DATA

-- Subject: Male/215 lbs/71 in --

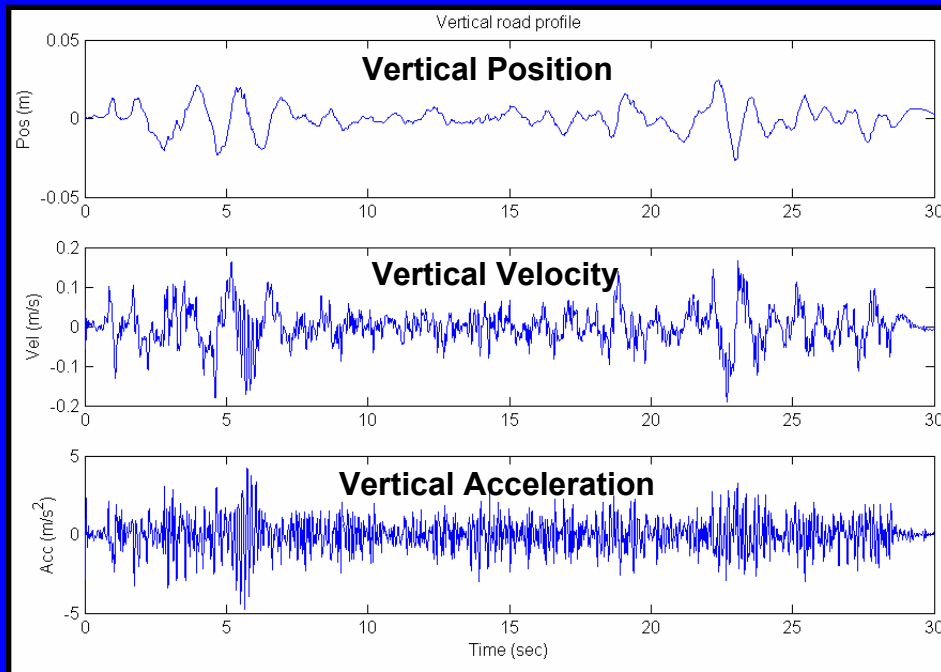


BIODYN FREQUENCY RESPONSE COMPARISON WITH RMS DATA

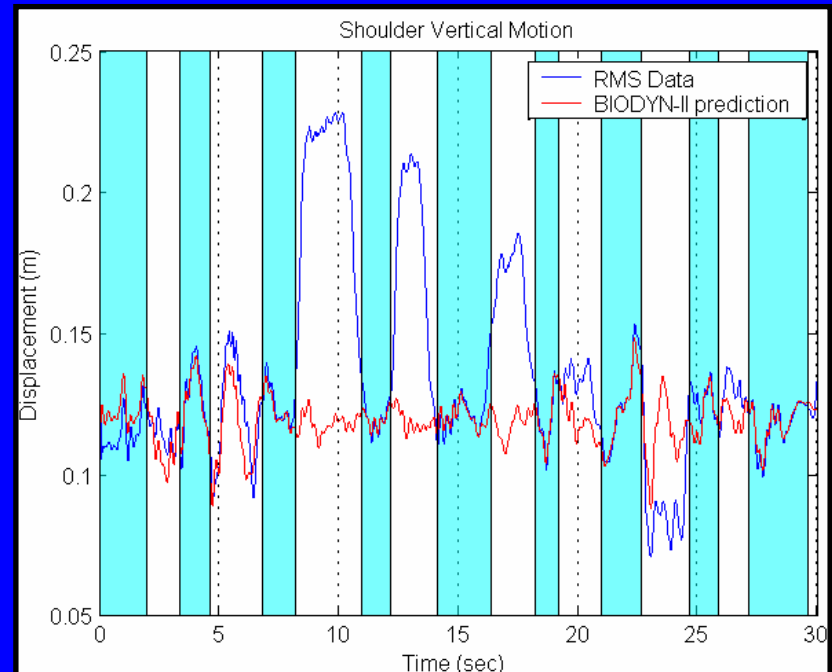


BIODYNAMIC MODEL COMPARISON WITH TACOM RMS DATA FOR A ROAD PROFILE

-- Biodynamic Model Fixed in Driving Position --



Road profile taken from measured proving ground course.

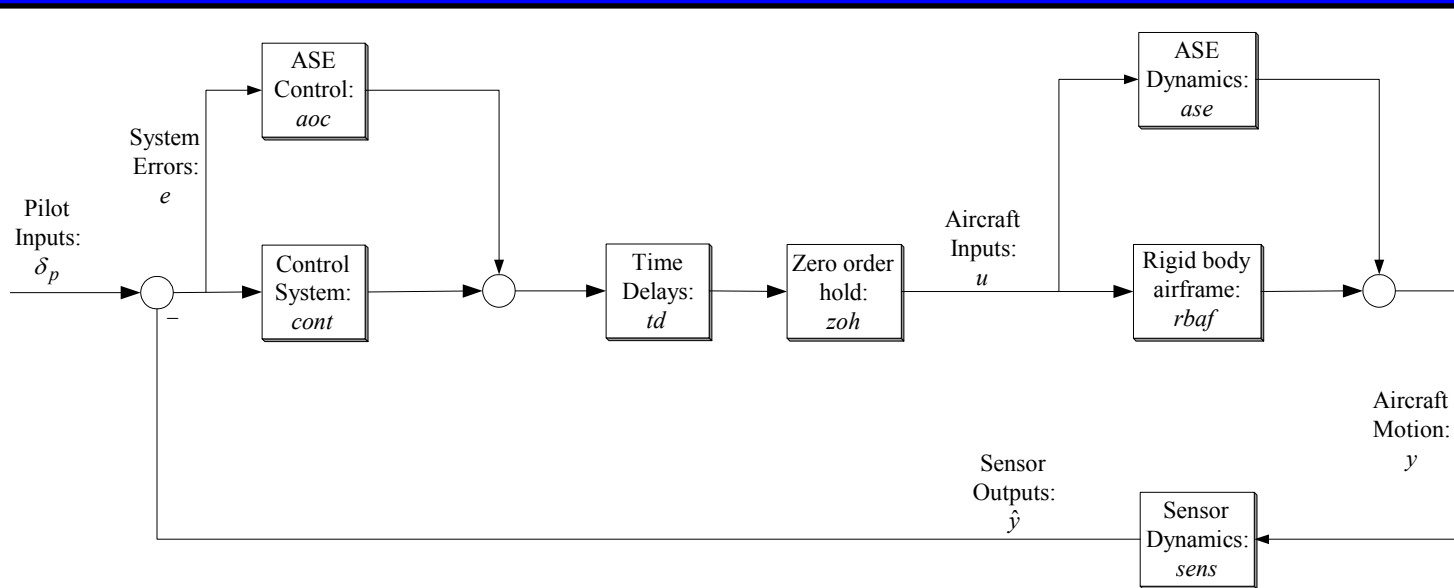


Blue bands indicate time segments with subject in driving position.

IMPROVED FLUTTER TEST TECHNIQUES USING WAVELETS

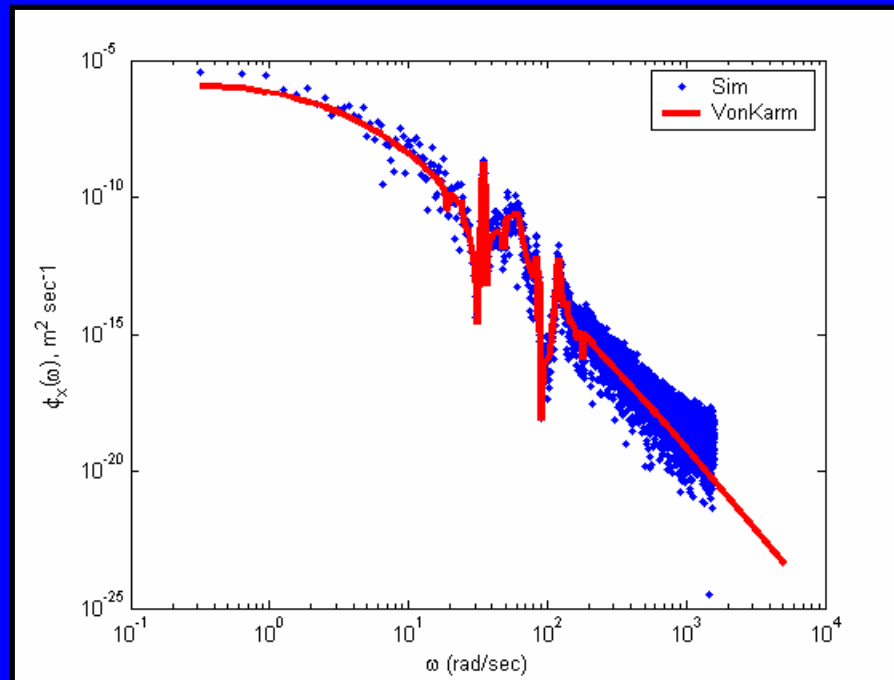
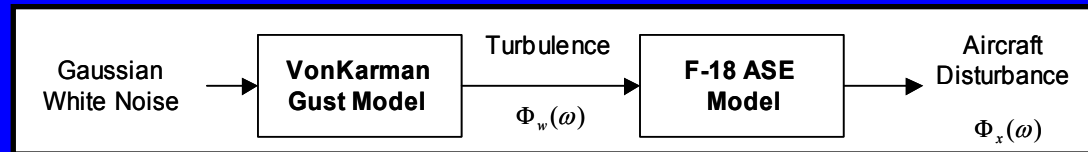
- Ongoing work for AFFTC as part of Phase II SBIR
- Wavelet-based techniques (WERA) have been developed that provide a rapid, on-line identification of aeroservoelastic systems (see AIAA Paper # 2004-6838 & AIAA Paper # 2004-5065)
- Current Program Status:
 - Developing techniques to automate the WERA process and assess sensitivity of the identification process to noise and disturbances
 - Converting Matlab m-files to a C-DLL (using some Matlab autocode features)
 - Integrating C-DLL into the IADS (Interactive Display and Analysis System) flight control room software package created by Symvionics, Inc.

F/A-18C MODEL DESCRIPTION

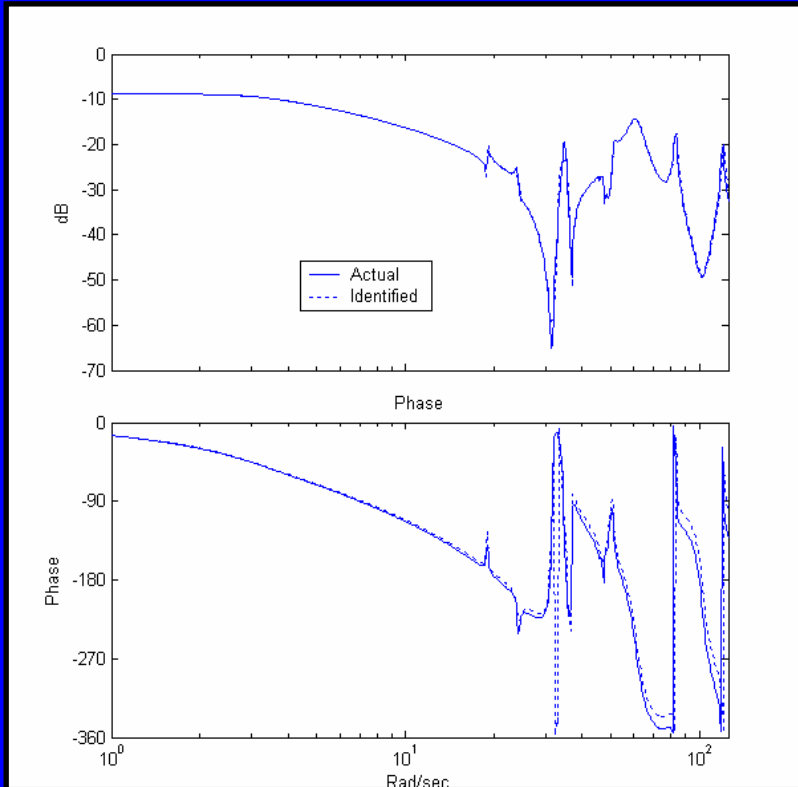


| Pilot Inputs: $\delta_p =$ | Sensor Outputs: $\hat{y} =$ | Aircraft Inputs: $u =$ | Aircraft Motion: $y =$ | (ASE Data) |
|----------------------------|-----------------------------|------------------------|------------------------|-----------------------------------|
| 1 Latstk in | 1 0 | 1 Dif LEF cmd deg | 1 Beta rad | 8,9 Ny fwd,aft g |
| 2 Pedal lbs | 2 0 | 2 Dif TEF cmd deg | 2 Phi rad | 10,11 P,R fwd rps |
| 3 0 | 3 Beta deg | 3 Dif Ail cmd deg | 3 Psi rad | 12,13 P,R aft rps |
| 4 0 | 4 Roll deg | 4 Dif Stab cmd deg | 4 Roll Rate rps | 14-16 Nz wing row 1 fwd,mid,aft g |
| 5 0 | 5 Yaw deg | 5 Coll Rudder cmd deg | 5 Yaw Rate rps | 17-19 Nz wing row 2 fwd,mid,aft g |
| 6 0 | 6 Roll rate deg/sec | | 6 Ny rbcl g | 20-22 Nz wing row 3 fwd,mid,aft g |
| 7 0 | 7 Yaw rate deg/sec | | 7 Ny aoc g | 23-26 Nz wing row 4 fwd,mid,aft g |
| 8 0 | 8 Ny rbcl g | | | 26,27 Nz inbrd store fwd,aft g |
| 9 0 | 9 Ny aoc g | | | 28,29 Nz outbrd store fwd,aft g |
| | | | | 30,31 Nz tip missile fwd,aft g |

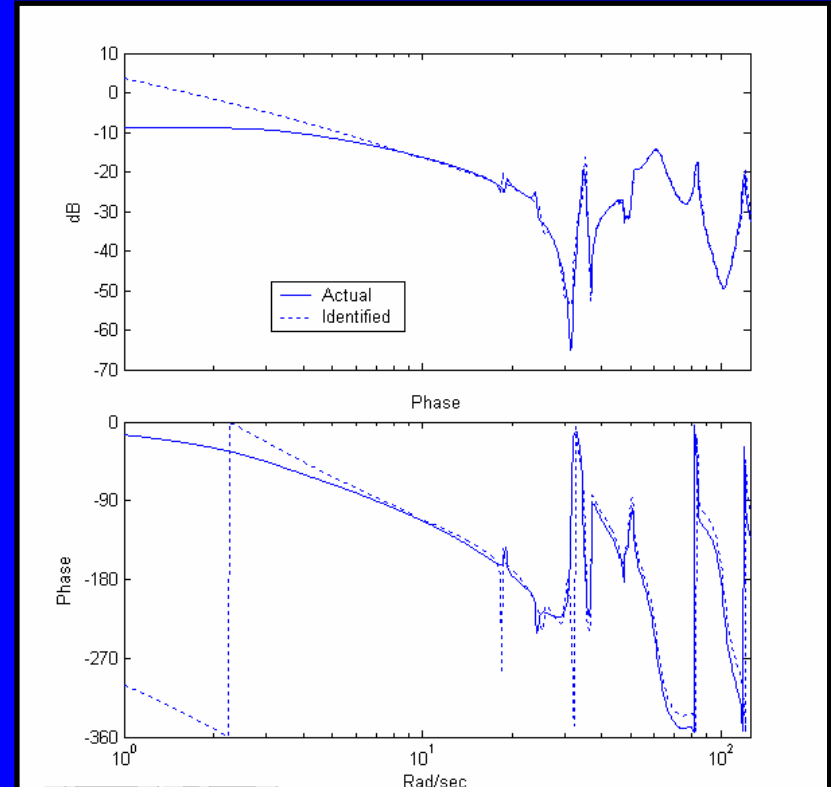
COMPARISON OF SIMULATED AIRCRAFT & GUST SPECTRUM WITH THEORETICAL VON KARMAN SPECTRUM



IDENTIFIED FREQUENCY RESPONSE COMPARISOM



Clean Air Identification



Identification with Gust Disturbance