Integrating Structural Analysis and Test at GSFC

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Outline

- **Objectives**

- **Modules:**
  - Swept Sine and Random Analysis & Test (A&T)
  - Base Driven Modal Survey A&T
  - Shock A&T
  - Acoustic A&T
  - Mass properties/Static/Dynamic Balance A&T

- **Status & Conclusions**

Objectives

- **To automate repetitive processes in structural A&T.**
- **To integrate and speed up pre-test analysis, test planning, test execution and test reporting.**
- **To create a project vibration database useful for the project itself and for future research.**
- **The program should be portable, available and easy to run in any PC and should allow "near-real time" test e-data processing"**

Swept Sine and Random Vibration Module

Analysis INPUTS:

Reduced [M,K] or Physical [pch FRF]
Test channels (A-set)
Channels for MS calculations
Test Specification
Test Limits

Test INPUTS:

UFF [spectrums or T(f)] from DAS
Excel worksheet from Controller
Test limits

User Interface

Excel- ActiveX Controls

Analysis Data Process

Fortran /
Excel-Visual Basic

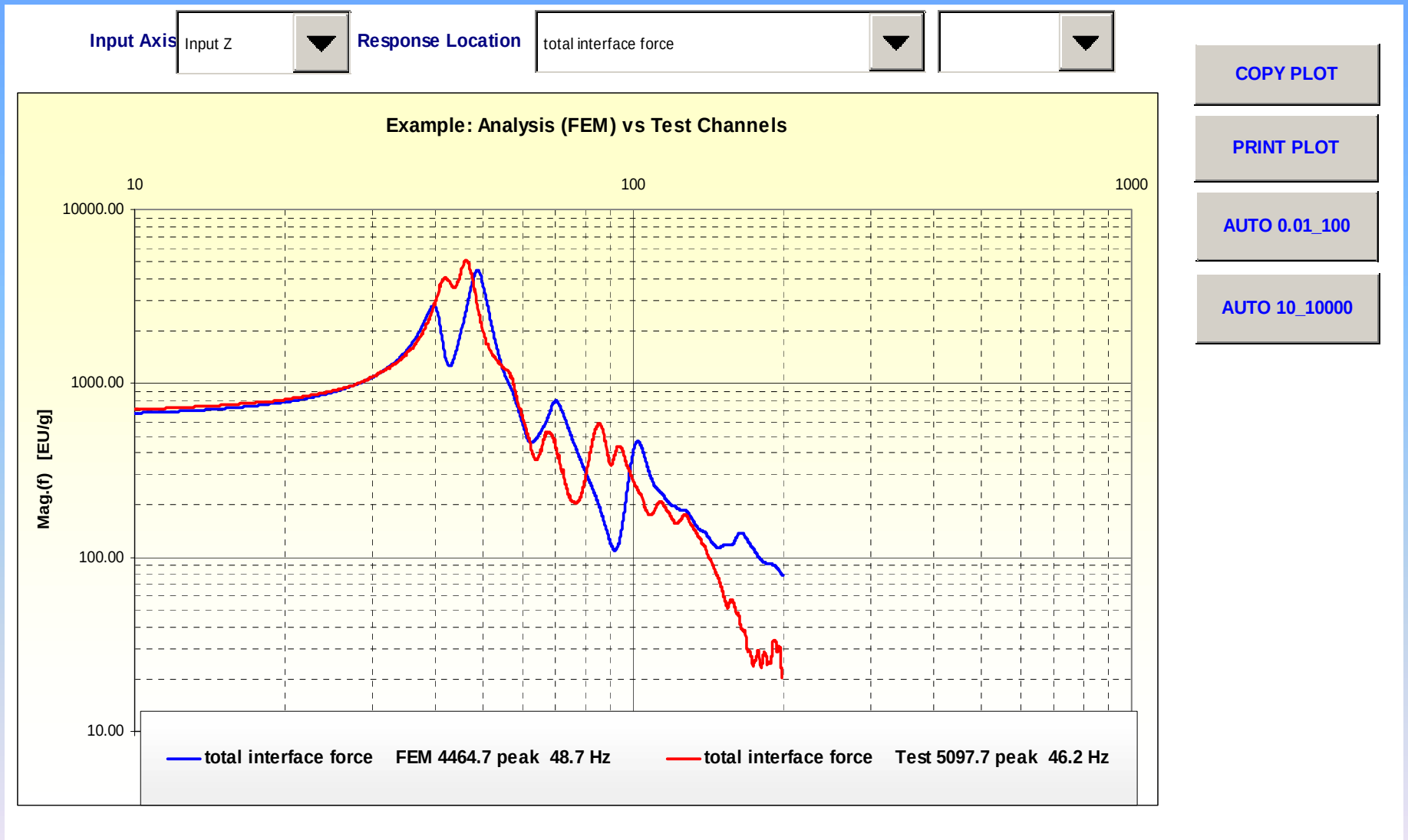
Test Data Process

Excel-Visual Basic

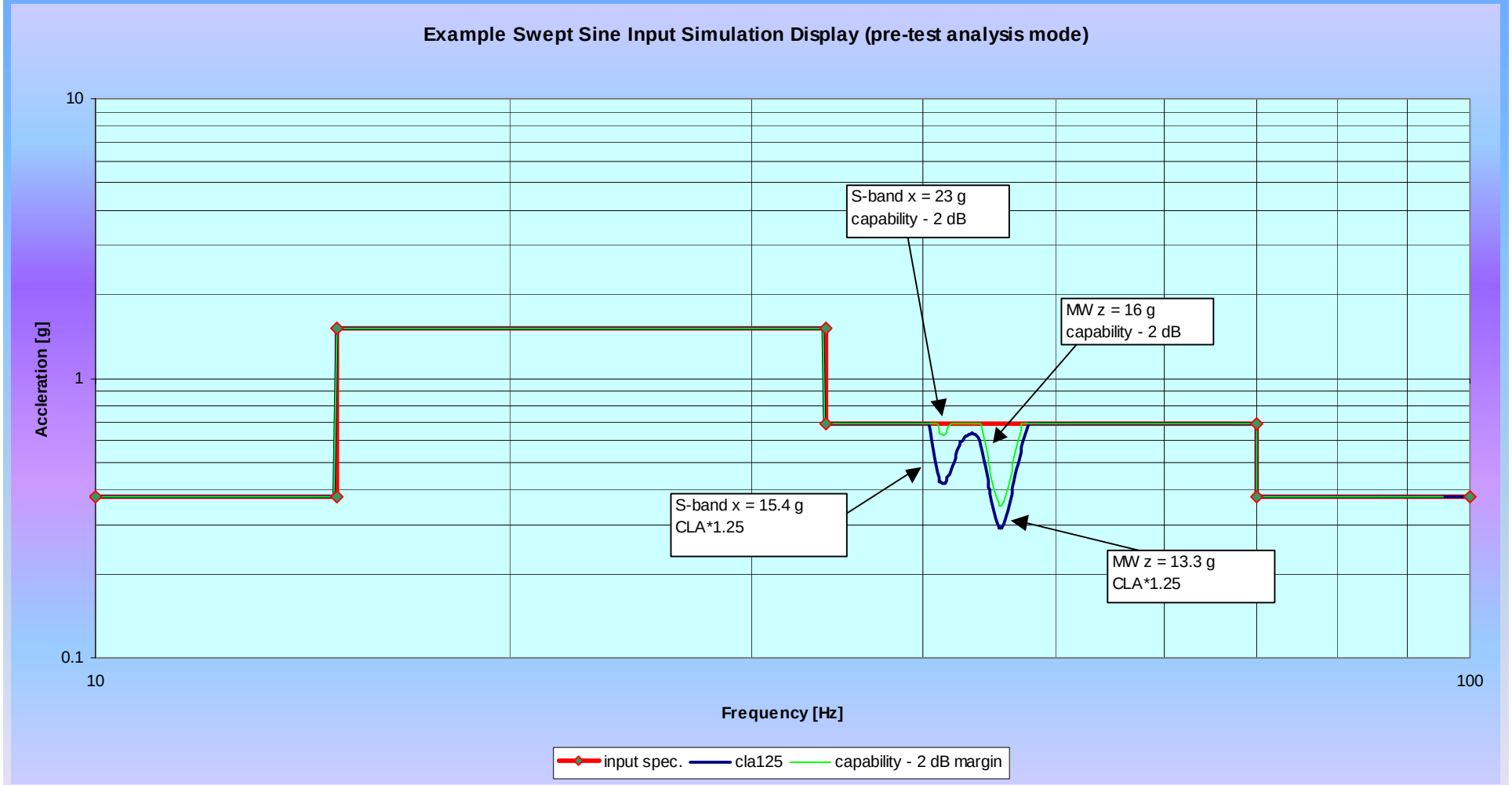
OUTPUTS:

- Instrumentation table for test plan
- Force Limits for Random Vibration (7 methods)
- Tables of max, min, rms's
- Scaling to intermediate /full level
- Pre-post test signatures graphic display
- Limit channels / values for test plan
- Test simulation (I/O with and without limits)
- Steady State / and % of SS
- A&T channels display [psd's, spectrums or T(f)]
- Output vibration database

Example of analysis – test channels plot



Example of pre-test analysis plot



Base Driven Modal Module

Analysis INPUTS:
Maa
Φaa

Test INPUTS: (swept sine or random inputs)
UFF[T(f)] from DAS

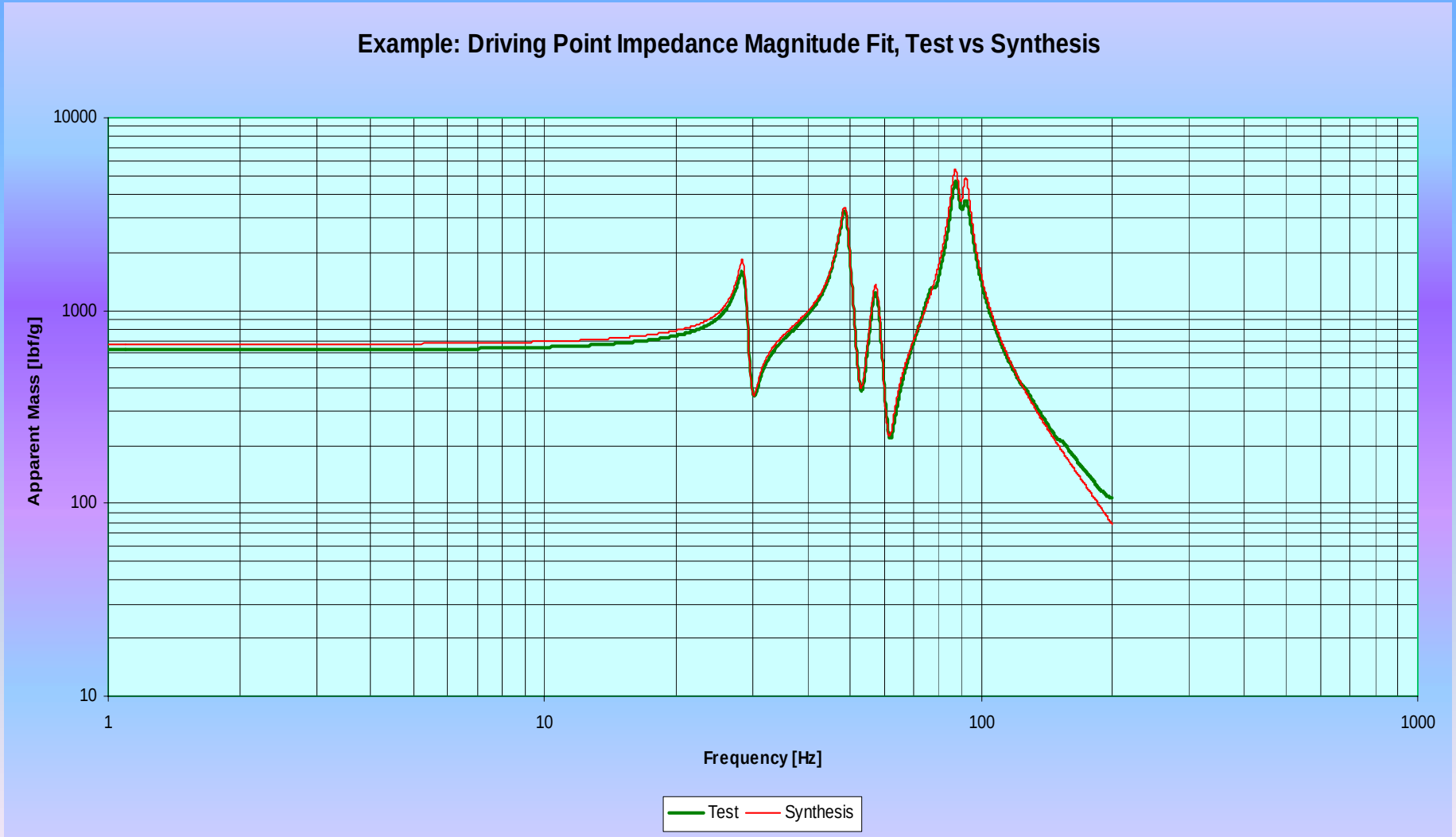
User Interface
Excel- ActiveX Controls

Test/Analysis Data Process
Excel-Visual Basic

OUTPUTS:

- Instrumentation table for test plan
- Linearity checks
- Mode Shapes Φat
- Orthogonality Checks / outputs to test report
- Channels graphic display pre-during [T(f)]
- Damping, Participation Factor
- Metrics: MAC, MSF

Example of impedance curve fit



Shock Module

Analysis INPUTS:

Aa(t)
Fa(t)
Geometry
Load path description
Input SRS

Test INPUTS:

UFF [At(t), Ft(t)] from DAS
Excel worksheet from CTLer
Sine Burst, Time Replication, Shock

User Interface

Excel- ActiveX Controls

Test/Analysis Data Process

Excel-Visual Basic

OUTPUTS:

- Shock prediction (SIMO)
- Instrumentation table for test plan
- Shock Response Spectra
- Channels graphic display frequency dom.
- Fourier Coefficients
- Displacement, Velocity calculations
- Channels graphic display time domain.
- Scaling to full level
- Transfer Functions

Acoustic Module

Analysis INPUTS:
Allowables
FEA, BEA, SEA predicts
Reference SPL

Test INPUTS:
UFF [psd's, SPL] from DAS

User Interface
Excel- ActiveX Controls

Test/Analysis Data Process
Excel-Visual Basic

OUTPUTS:

- Instrumentation table for test plan
- Scaling to full level
- Conversions 1/3 – full octave
- Channels graphic display (psd's test vs allowables)
- SPL display and tables (Ref. Vs test)
- Outputs to test report

Mass Properties/Static/Dynamic Balance Module

Analysis INPUTS:
Item mass properties
Static/Dynamic Requirements

Test INPUTS:
Static, Dynamic Unbalance
@ machine measurement plane

User Interface
Excel- ActiveX Controls

Data Process
Excel-Visual Basic

OUTPUTS:

- Calculation of subsystem and global M, CM, Inertias for all configurations (dry, wet, launch configuration, GTO post AKM burn, BOL, EOL, etc)
- Static / Dynamic Unbalance (Inertias and angles)
- Optimum Balance weights / location calculation

Status & Conclusions

- **Accessible analysis tool / learning for junior engineers.**
- **All the routines have been developed or identified. The program is being assembled/debugged.**
- **The base driven modal package is being validated with test data.**
- **Program runs in a common UI, portable, easy to run.**
- **Allows focus in processed data as opposed to data processing.**
- **Program growth: new calculation routines can easily be incorporated by programming VB or by calling an external executable.**