



THE INNOVATOR IN
**SOUND & VIBRATION
TECHNOLOGY**

WELCOME





CREATE A SINE ON RANDOM TEST USING FIELD DATA

THE INNOVATOR IN
**SOUND & VIBRATION
TECHNOLOGY**





CORE VALUES

COLLABORATION

CAPABLE & COMPETENT

ACCOUNTABLE & RESPONSIBLE

STRONG & DRIVEN WORK ETHIC

DO THE RIGHT THING

INNOVATION





INTRODUCTION

TEST MODES USED FOR GENERATING A TEST BASED ON REAL-WORLD DATA

- Field Data Replication
- Random Import
- Fatigue Damage Spectrum
- UDT/SRS
- Sine Tracking, Analysis & Generation (STAG)



Field Data Replication



Random Import



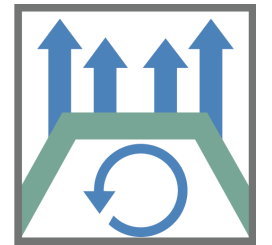
Fatigue Damage Spectrum



Shock Response Spectra



User Defined Transient

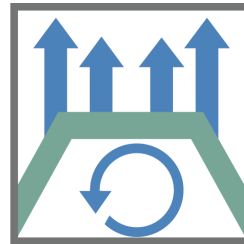


Sine Tracking, Analysis & Generation



INTRODUCTION

- The Problem:
 - Engine Test and Shaker Test don't generate the same failure
- Investigate the Data:
 - Evaluate the Engine Environment and compare with Shaker Test data
 - The Engine Environment had very dominant narrow peaks related to RPM
 - The Shaker Test seemed much higher in overall GRMS, but lacked the 'peaks'
- Research
- Create a Solution



Sine Tracking,
Analysis &
Generation



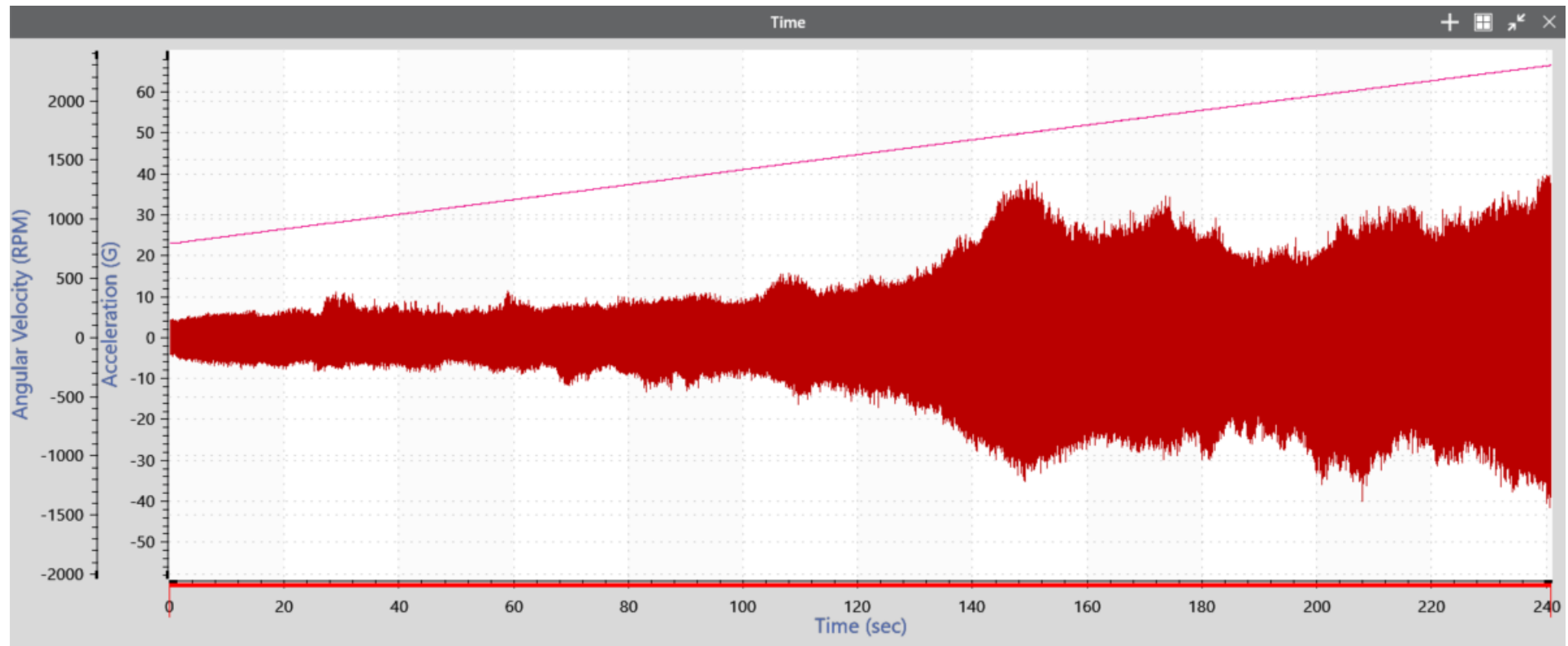
ORDER ANALYSIS

- What is an Order?
 - The number of events that occur per revolution
 - 1st Order Events happen once per revolution
 - 3rd Order Events happen 3 times per revolution
- What is Order Tracking?
 - Using a changing RPM reference to analyze the events that occur per revolution
 - Used to separate the rotational energy from the broadband random
 - A RPM vs. Frequency Spectrogram is typically used for viewing
- What environments can be analyzed?
 - Engine Ramp Up, Coast Down
 - Engines, Gear Boxes, Transmissions, Turbines, Pumps, Motors, etc



ORDER ANALYSIS

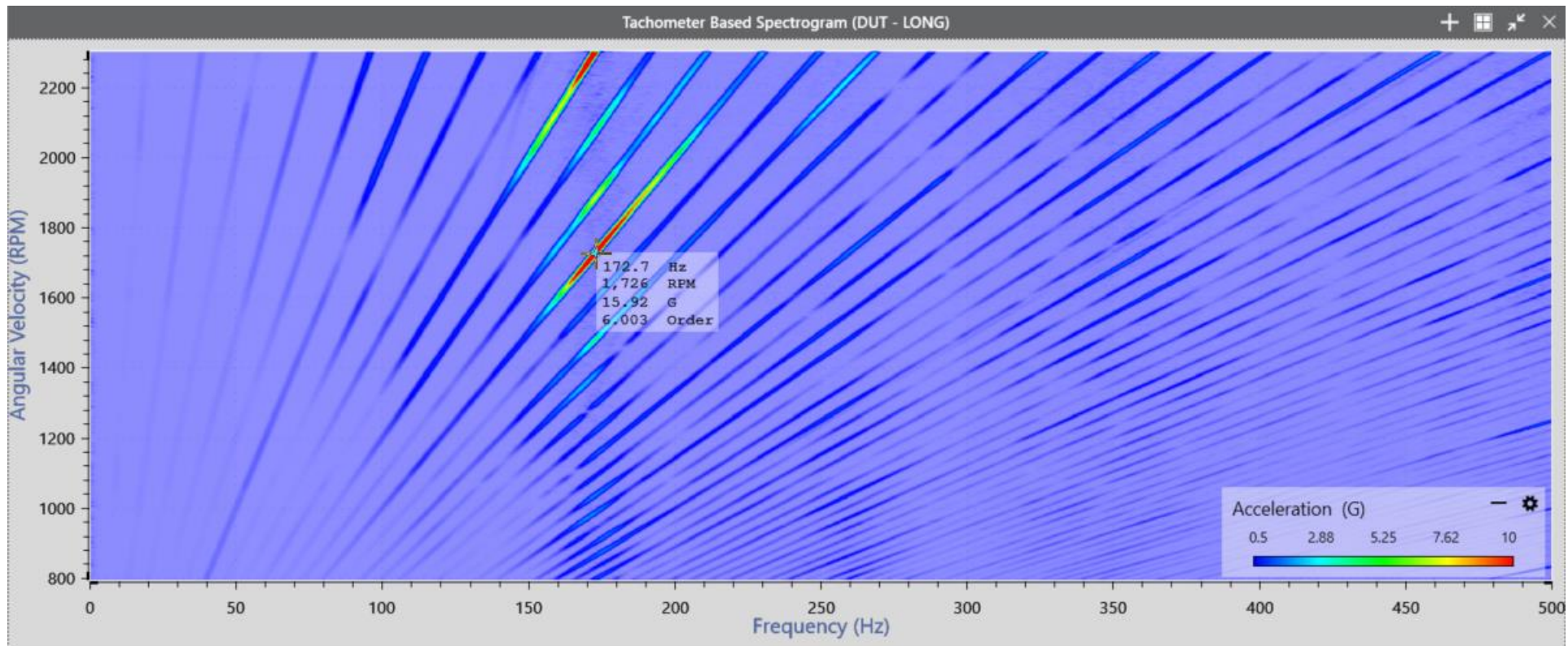
THE TIME HISTORY DATA MUST INCLUDE AN RPM REFERENCE TRACE AND SENSOR DATA





ORDER ANALYSIS

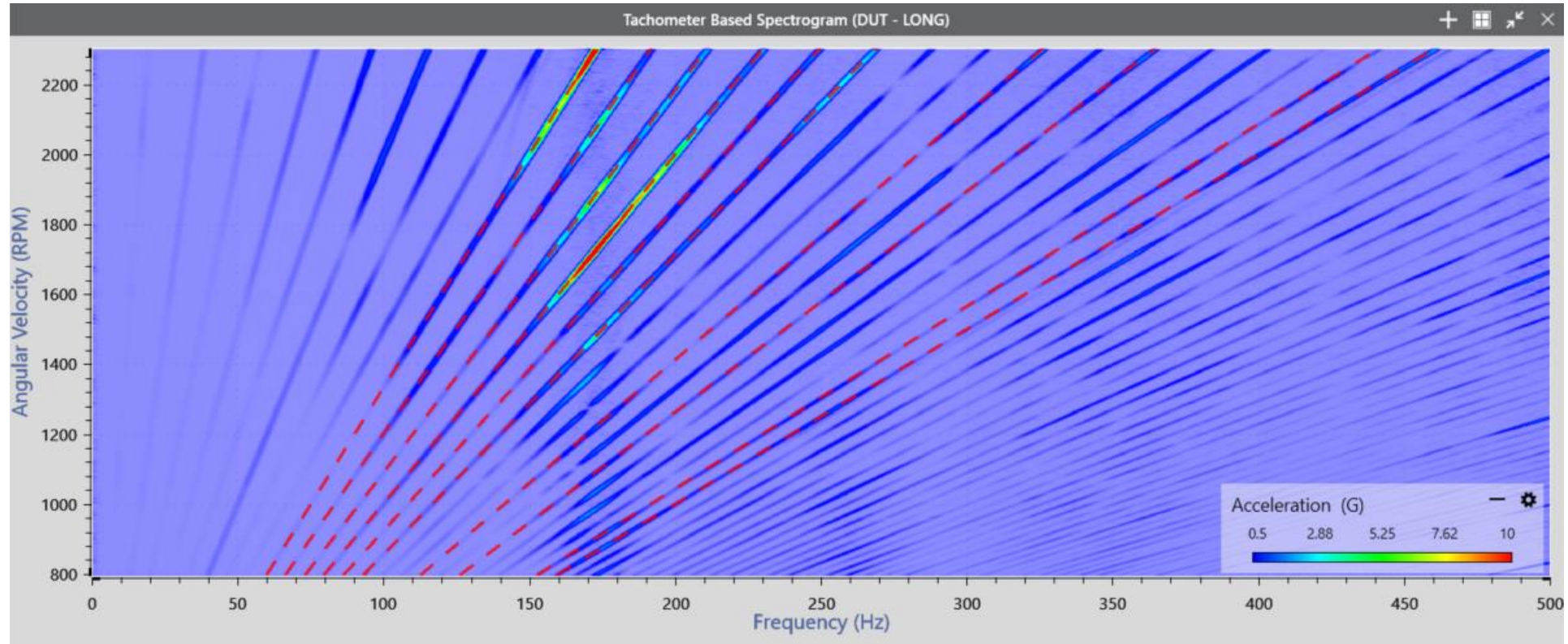
THE RPM VS. FREQUENCY SPECTROGRAM IS USED TO HIGHLIGHT AND VIEW ORDER CONTENT





ORDER ANALYSIS

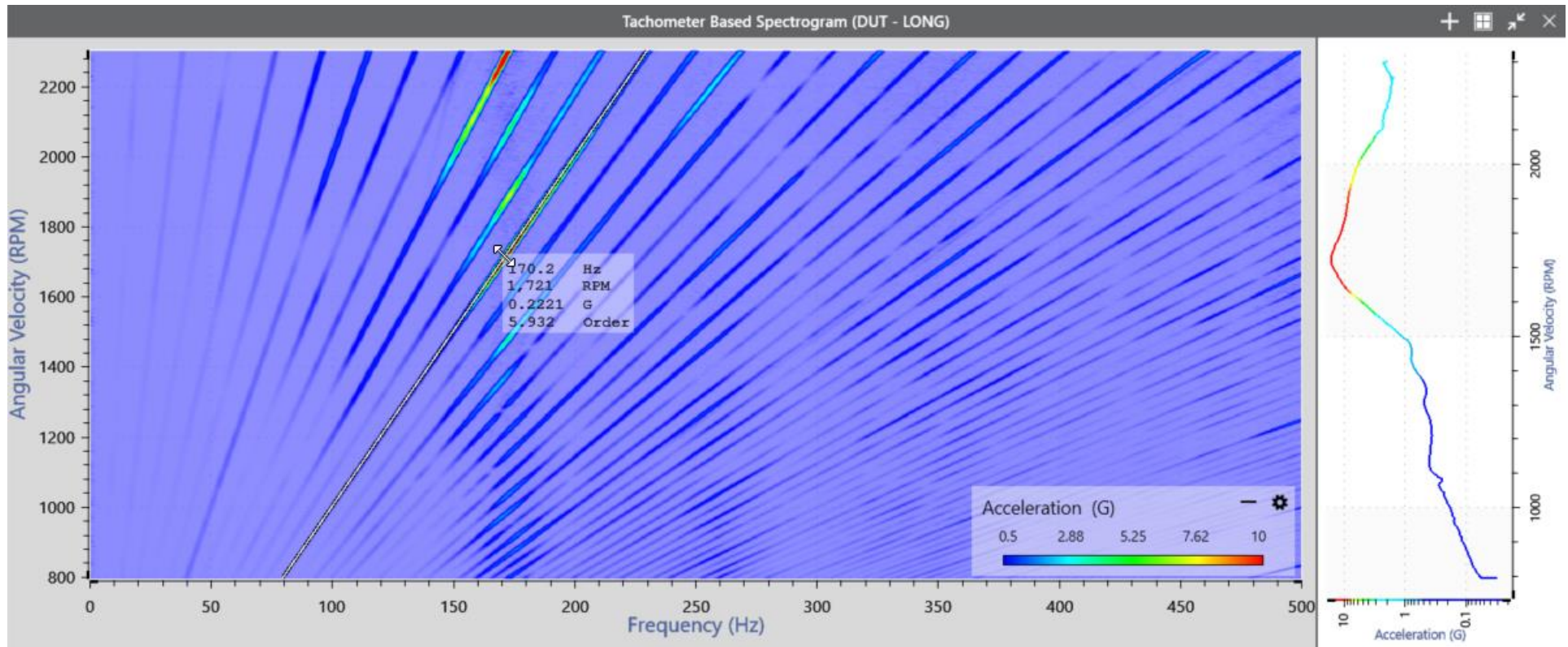
THE “ADD TOP 10 ORDERS” BUTTON WILL AUTOMATICALLY MARK THE APPROPRIATE ORDERS





ORDER ANALYSIS

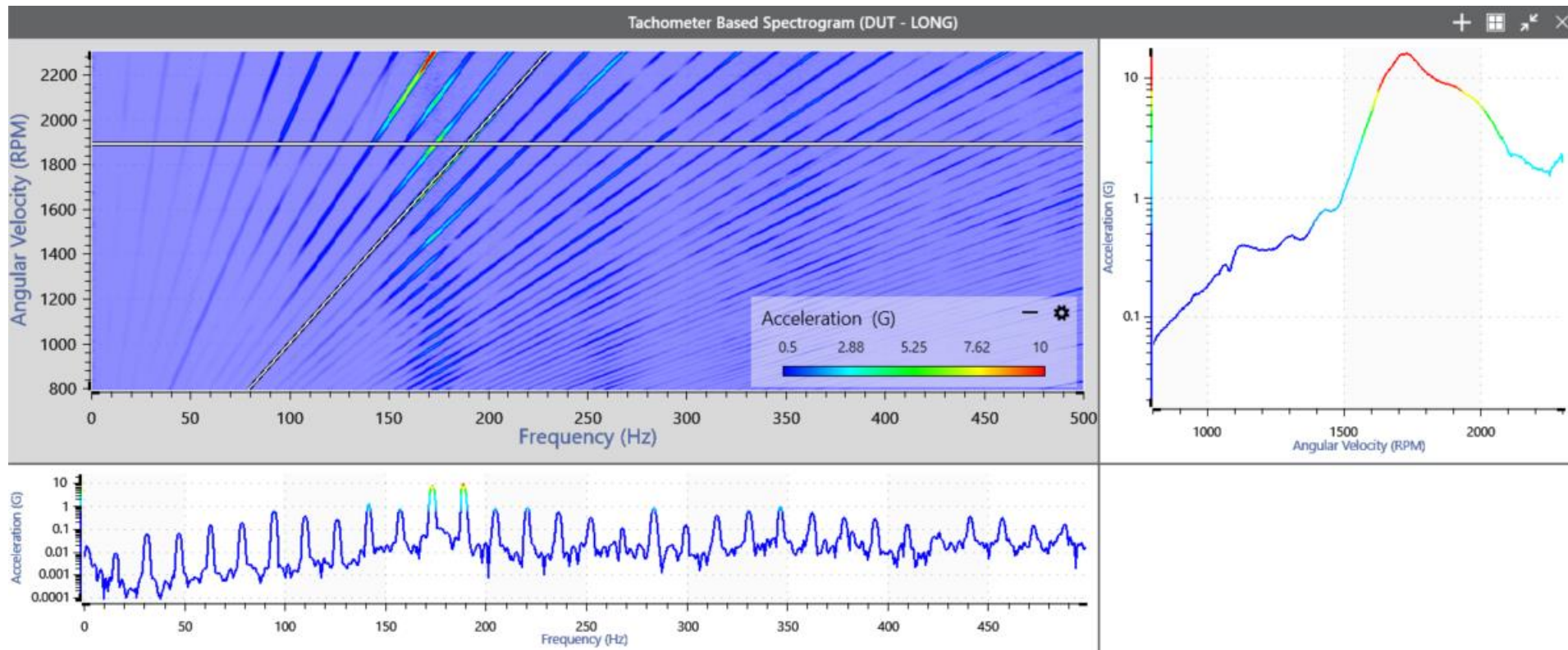
USE THE ORDER CURSOR AND ORDER CROSS SECTION GRAPH TO VIEW ORDER DATA





ORDER ANALYSIS

VIEW THE HORIZONTAL CURSOR (FFT SLICE) TO MONITOR PEAK GENERATED BY CHANGE IN RPM





SINE PROFILE ACCELERATION

- Select orders that excite the structural resonances of the DUT
- Accelerate the Sine Tone Profiles using the Inverse Power Law
 - 'm'
 - Target Life
 - Test Duration
 - # of sweeps
- Manipulate the Sine Tone Profiles for the desired result
 - Sine Tone Dwell
 - Sine Sweep
 - Narrowband Sweep

$$\frac{G_{Test}}{G_{Engine}} = \left(\frac{Time_{Engine}}{Time_{Test}} \right)^{\frac{1}{b}}$$

G_{test} = Test Level

G_{engine} = Engine Level

$Time_{engine}$ = Engine Expected Life

$Time_{test}$ = Test Time

b = negative inverse of SN fatigue life curve



GENERATE SINE TONE PROFILE(S) WITH STAG

SELECT ORDERS OF INTEREST, EVALUATE, MANIPULATE PROFILES FOR DESIRED PROFILES

Sine Tracking Analysis and Generation (STAG)

Settings

Channels Select all

- REF - VERT (G)
- REF - LONG (G)
- REF - LAT (G)
- DUT - LONG (G)
- DUT - LAT (G)
- DUT - VRT (G)

Channel Selection

Channel Groups: Group 1

Channel Group Name: Group 1

Tach channel: RPM

Properties

Test Acceleration

- L m Value: 8
- L Target Life: 10000 hrs
- L Test Duration: 100 hrs
- L Total Sweeps: 750
- L Sweep Rate Linear (min/sweep): 8 min
- L Min RPM: 796.59 RPM
- L Max RPM: 2303.4 RPM

FDS

Filter

Test Acceleration Parameters

Orders

Traces

- Envelope accelerated (Order 3)
- Envelope accelerated (Order 4.5)
- Envelope accelerated (Order 5)
- Envelope accelerated (Order 5.5)
- Envelope accelerated (Order 6)
- Envelope accelerated (Order 6.5)
- Envelope accelerated (Order 7)
- Envelope accelerated (Order 7.5)
- Envelope accelerated (Order 9)
- Envelope accelerated (Order 12)
- DUT - LONG (Order 3)
- DUT - LONG (Order 4.5)
- DUT - LONG (Order 5)
- DUT - LONG (Order 5.5)
- DUT - LONG (Order 6)
- DUT - LONG (Order 6.5)
- DUT - LONG (Order 7)
- DUT - LONG (Order 7.5)
- DUT - LONG (Order 9)
- DUT - LONG (Order 12)

Order Number: 13 Accelerated values:

Order #	Segment Table	Min Freq. (Hz)	Max Freq. (Hz)	Q Value	Pk Amp. (G)	Pk Amp. Freq. (Hz)	Peak Vel (in/s)
3	Edit Tone	39.83	115.07	7.98	6.57	100	4.05
4.5	Edit Tone	59.75	172.61	30.58	29	172	10.4
5	Edit Tone	66.39	191.79	15.14	8.61	174	3.04
5.5	Edit Tone	73.03	210.97	21.81	13.9	173	4.94
6	Edit Tone	79.67	230.15	7.99	40.4	202	12.3
6.5	Edit Tone	86.30	249.33	21.01	4.02	236	1.31
7	Edit Tone	92.94	268.51	13.62	9.43	247	2.74
7.5	Edit Tone	99.58	287.68	12.12	4.48	267	1.56
9	Edit Tone	119.50	345.22	52.77	5.11	289	1.47
12	Edit Tone	159.33	460.30	33.76	4.76	448	1.29

Top 10 Orders, Statistics & Sine Tone Profiles



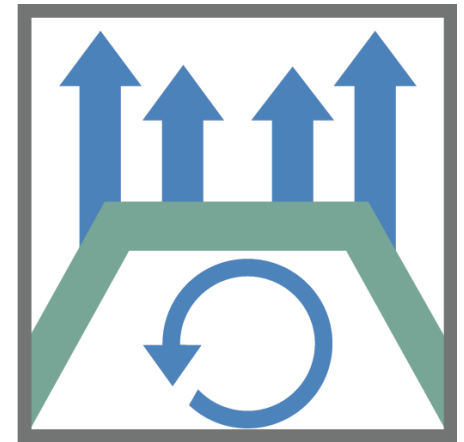
EXPORT TO VIBRATIONVIEW

- Selected orders are extracted from the original time waveform
- Sine Tone Profile(s) are exported to a Sine on Random Test Profile
- Test Acceleration Parameters are exported to VibrationVIEW
- A new time history with the selected orders removed is exported to VibrationVIEW
 - The new time history file is analyzed with FDS to generate the RANDOM test



BENEFITS OF STAG

- Short Processing Time
 - Easy to use, Easy to make Changes, Easy to repeat
- Automated Profile Development
- Simplified Process with minimal information required
- Modifications are displayed immediately
- Accurate analysis and profile development
 - 1000+ points in the sine tone profile for accurate definition



Sine Tracking,
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LIVE DEMONSTRATION

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ANY QUESTIONS?

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