

Classical Shock Testing Theory and Application



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VR Core Focus

To make the world's most innovative sound and vibration technology tools, enabling our customers to make reliable decisions and trustworthy products

Company Values

Strong & Driven Work Ethic

We do the Right Thing

Capable & Competent

Accountable & Responsible

Collaboration

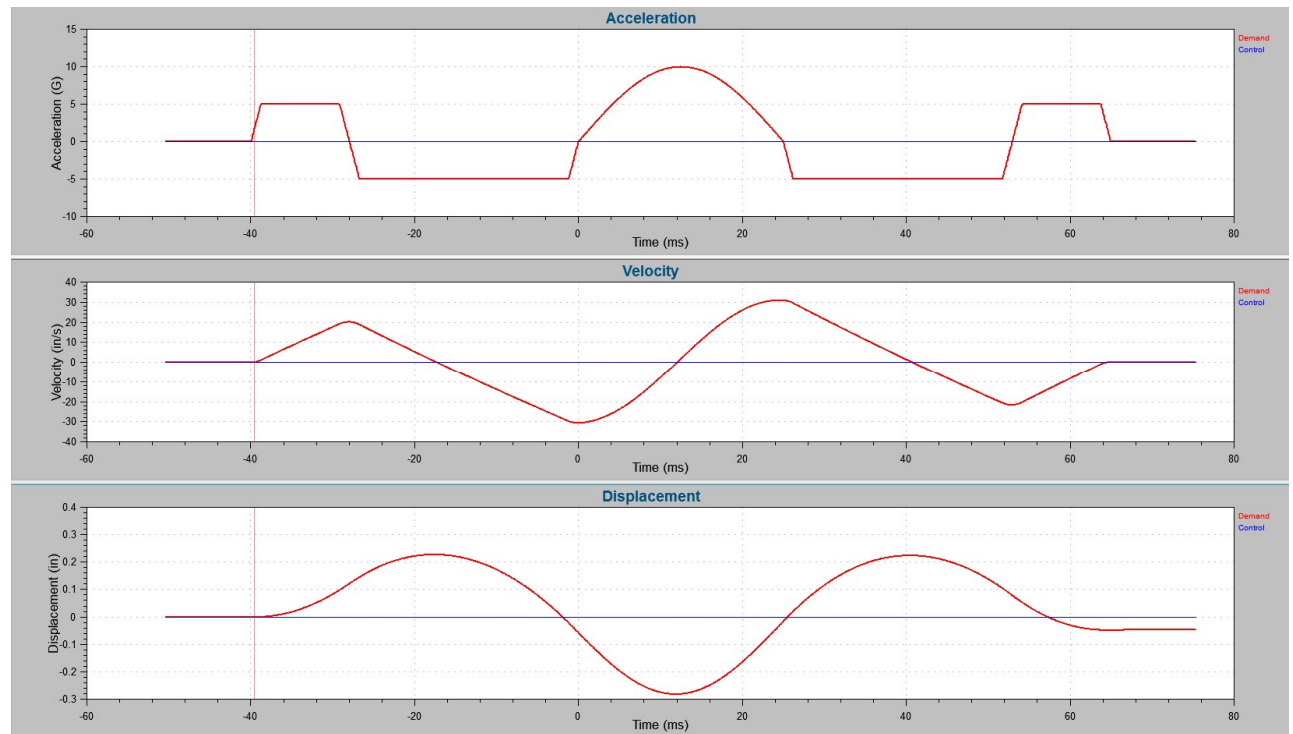
Innovation

Pulse Compensation

- In order to run a test on a shaker, pre and post pulse compensation must be added
 - Pre/Post Pulse ensure that Acceleration, Velocity and Displacement = 0 at the end of the pulse
 - Utilize more of the maximum displacement of a shaker
- Pulse compensation changes the shock pulse and distorts the spectrum

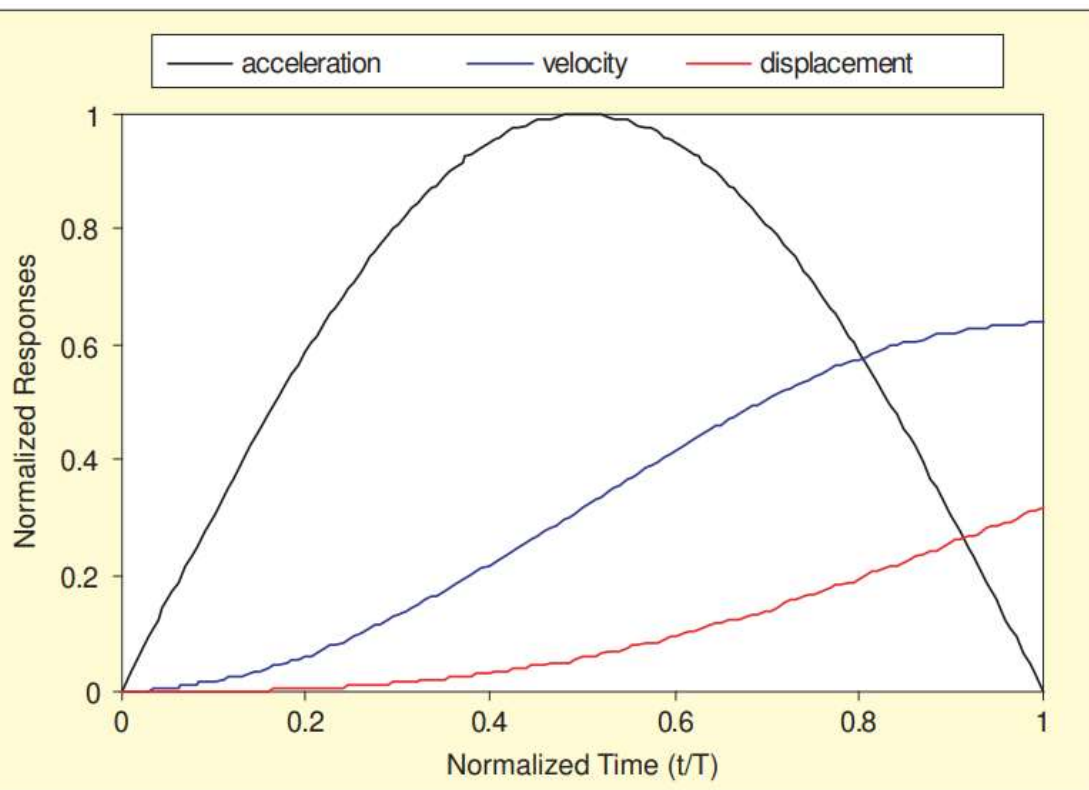


Pre/Post pulse compensation



No Pulse Compensation

- Without compensation the displacement will continue to increase until something stops it
 - Mechanical limits of the shaker!
 - Gravity

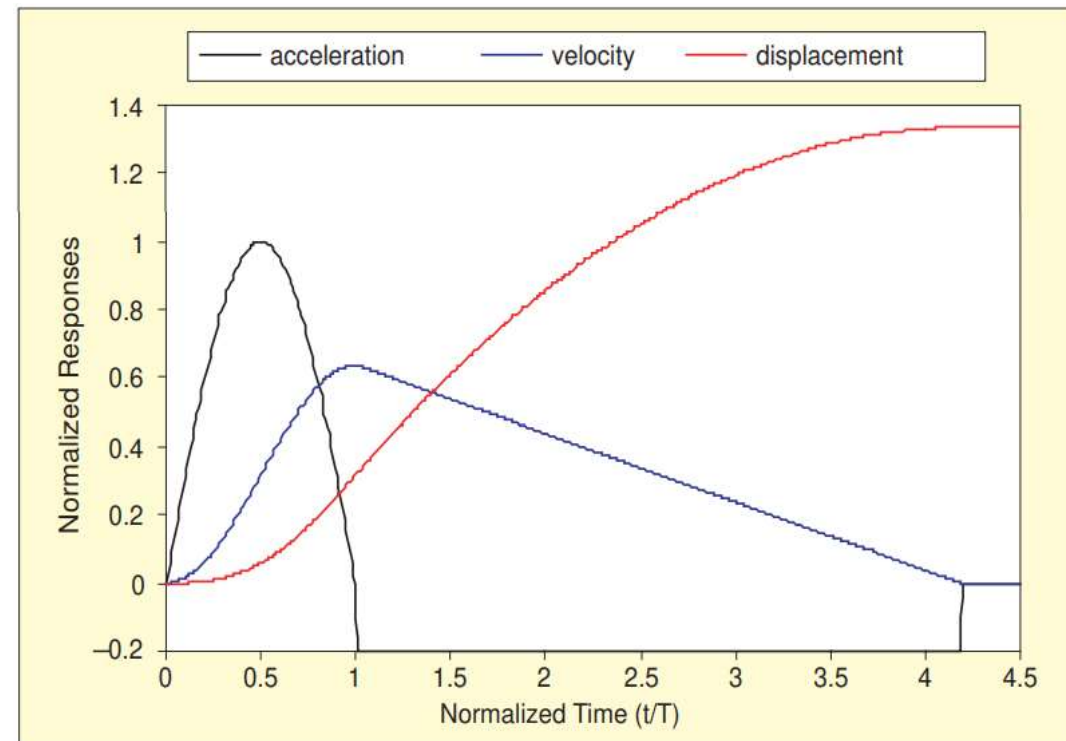


Shock'n on Shakers - George Fox Lang

<http://www.sandv.com/downloads/0309lang.pdf>

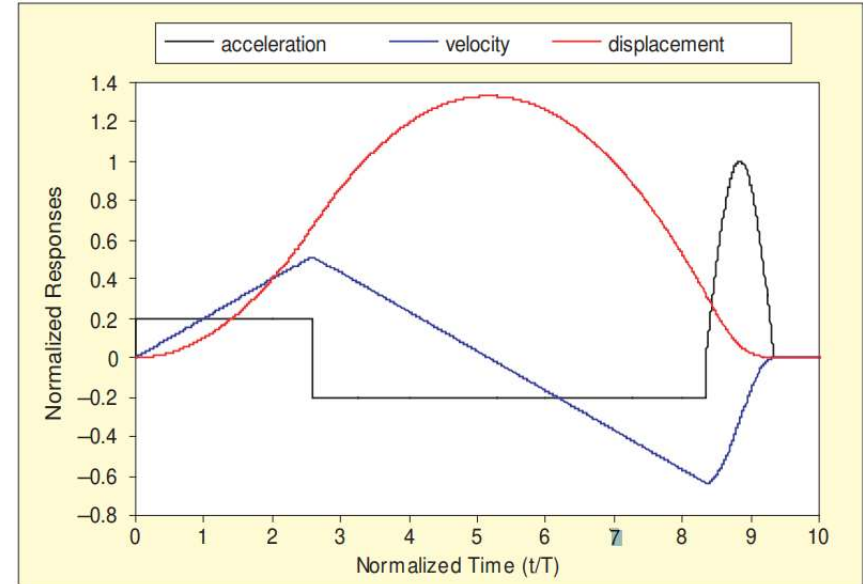
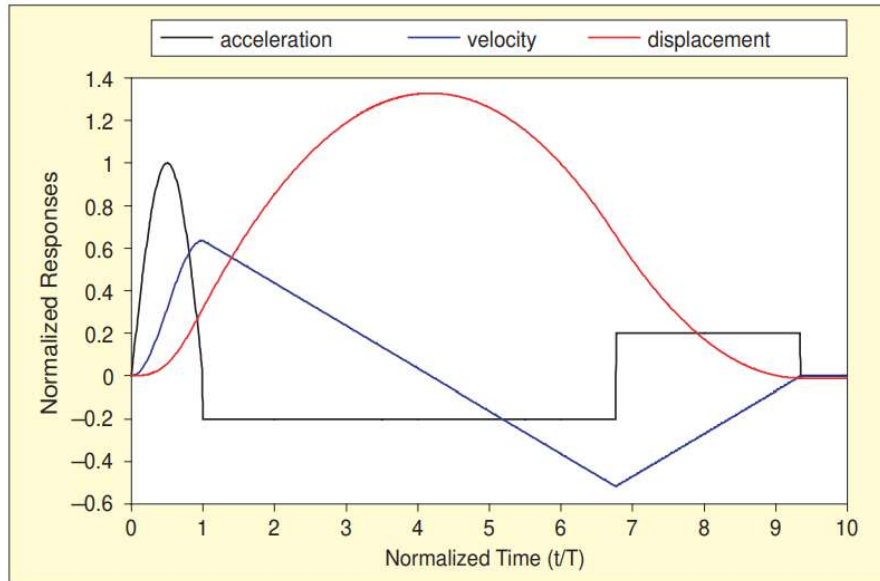
Pre/Post Pulse Compensation

- 1 Direction Pulse ONLY
 - Drives velocity to zero
 - Displacement is still non-zero!



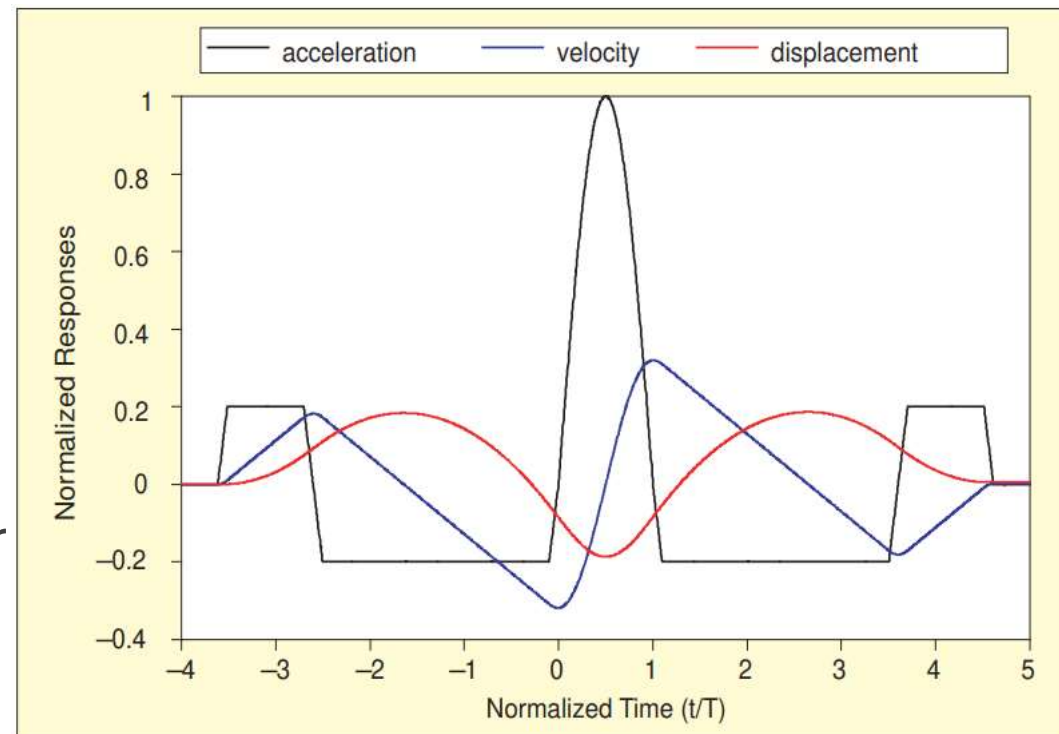
Pre/Post Pulse Compensation

- TWO Pulses of opposite directions drive both displacement and velocity to zero!



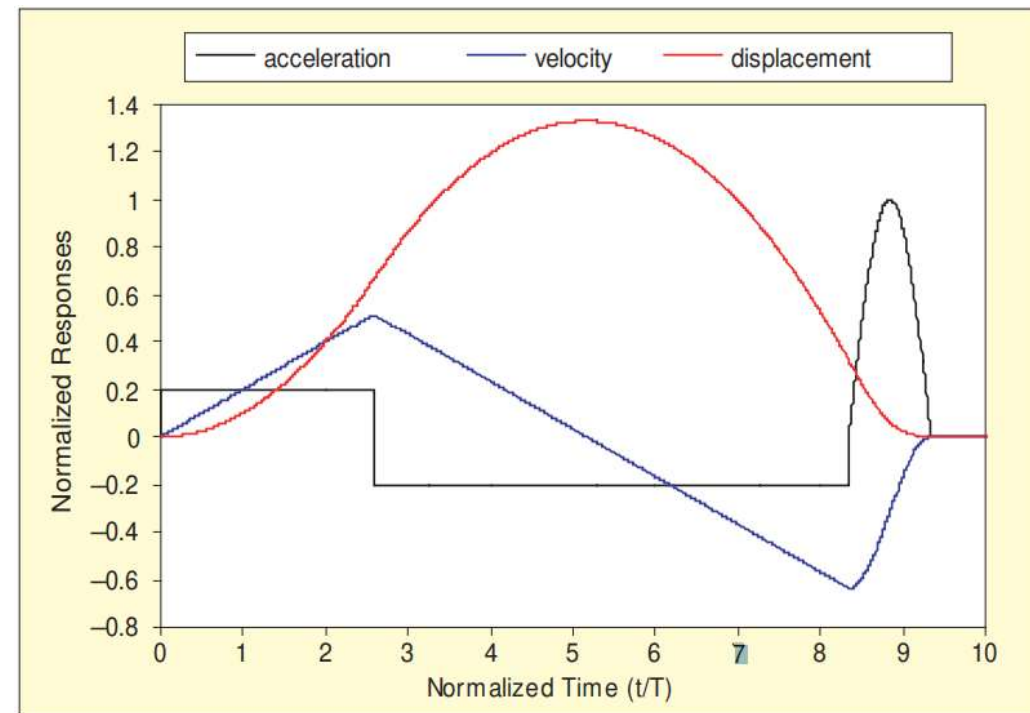
Pre/Post Pulse Compensation

- Typical Shaker Test
 - Two pulse of opposite sign are added to bring both terminal velocity and displacement to 0
 - Lower amplitude compensation pulse will create a longer pulse duration
 - Large test objects require the full stroke and velocity of shaker



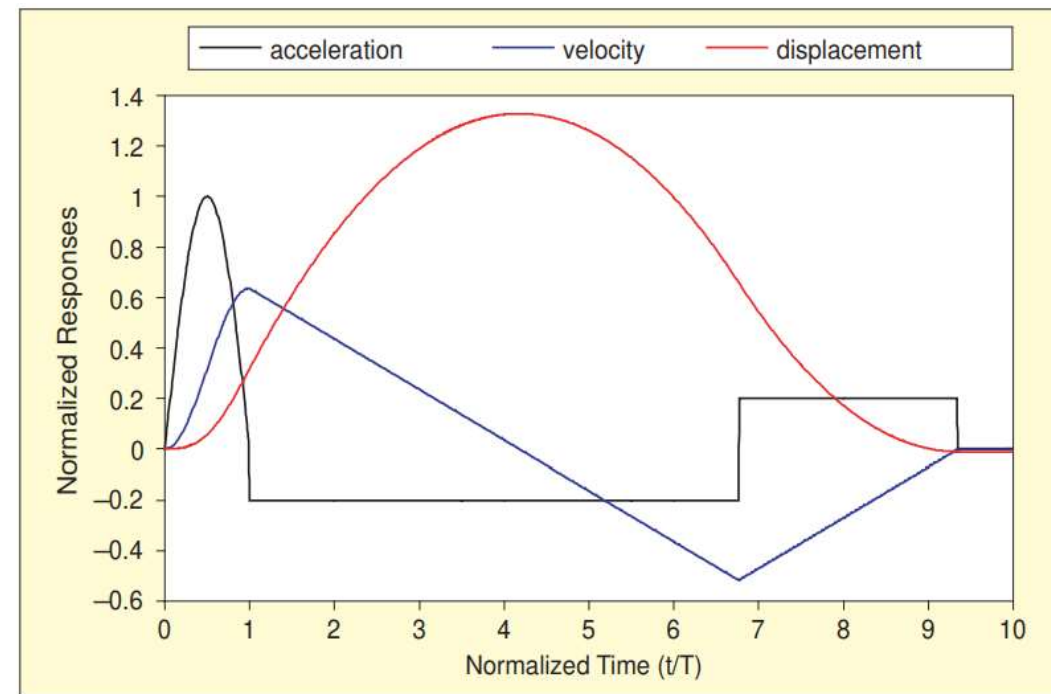
Pre/Post Pulse Compensation

- Pre-Pulse ONLY Compensation
 - Utilized for a disk-drive test
 - Test requires verification of the read/write functionality immediately after the shock



Pre/Post Pulse Compensation

- 20% Post pulse compensation
 - Utilized for Airbag sensor test
 - Requires measurement of the trigger level acceleration
 - Pre-pulse could pre-load the sensor and invalidate test results



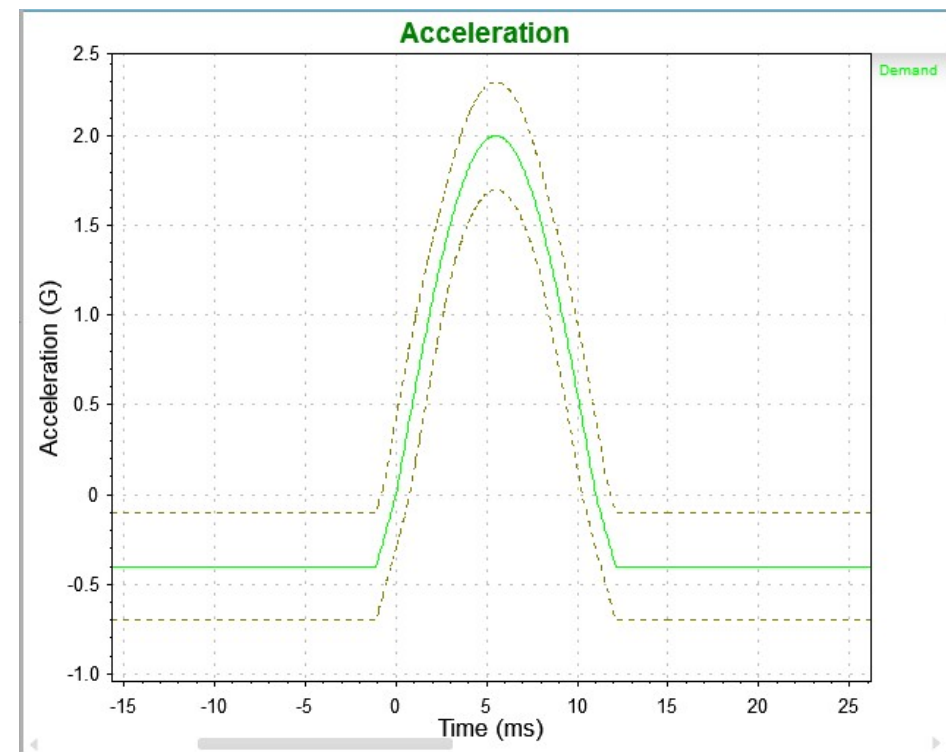


Characterizing Shock Pulses

- Amplitude
- Duration
- Rise and Fall Time
- Velocity change
- Pulse Shape
- Fourier spectrum
- Shock Response Spectrum

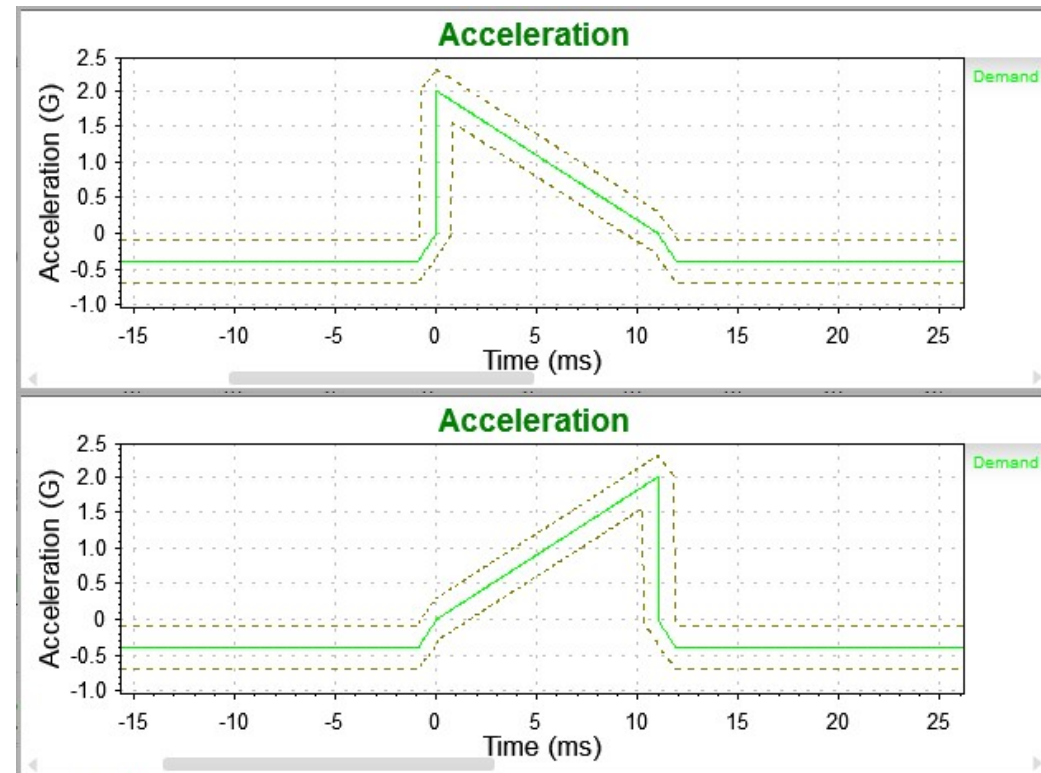
Half-Sine Pulse

- Traditional Method
- Very Common
- Frequency Response is smooth
 - Reduced high frequency content
 - “Holes” in higher frequency
- May not excite HF resonances



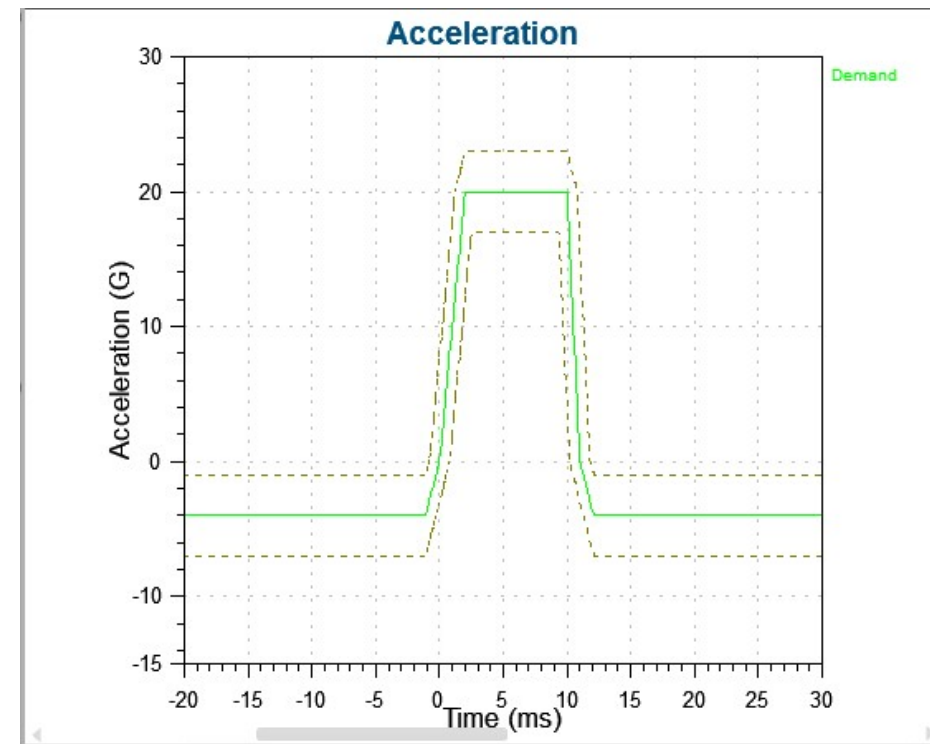
Terminal Peak (Sawtooth) Shock Pulse

- Many newer test specifications are using terminal peak rather than Half Sine
- The sharp point/peak increases HF content
- Fewer “Holes”
- Flat Spectrum

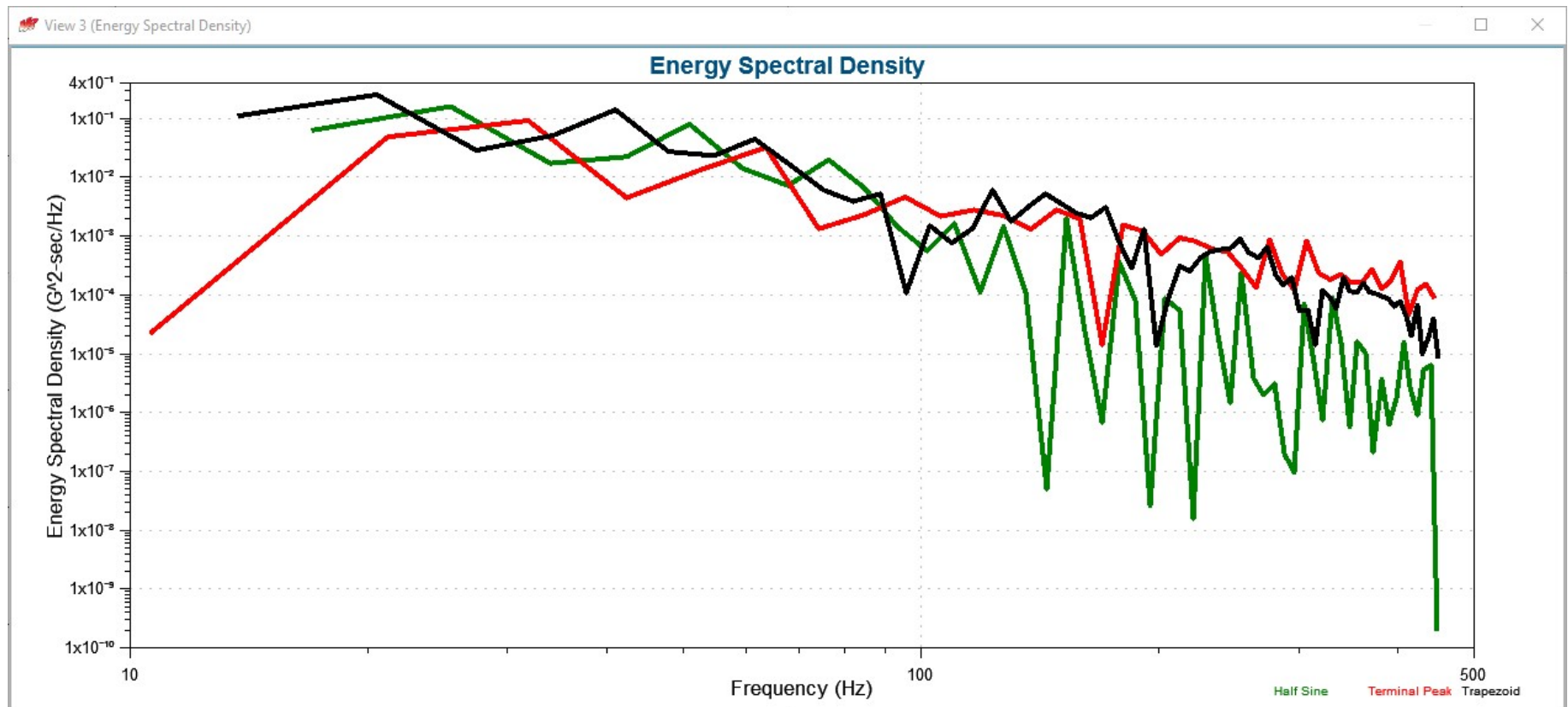


Trapezoidal Shock Pulse

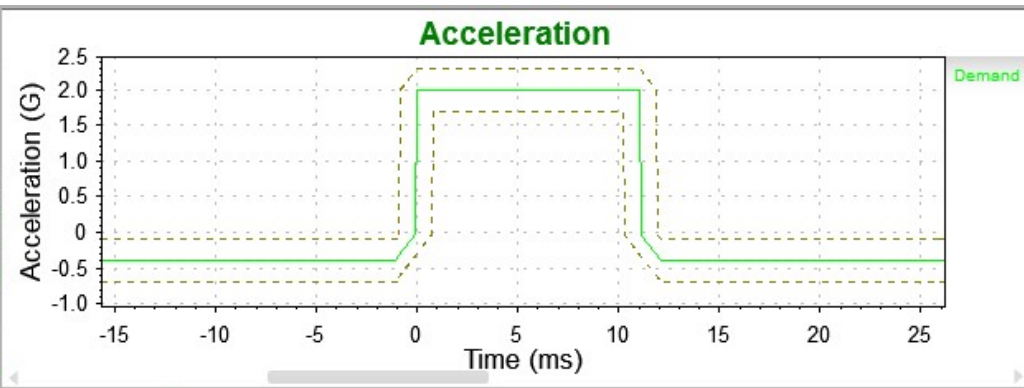
- Less common pulse type
- Points increase HF content
- High Velocity, High Displacement



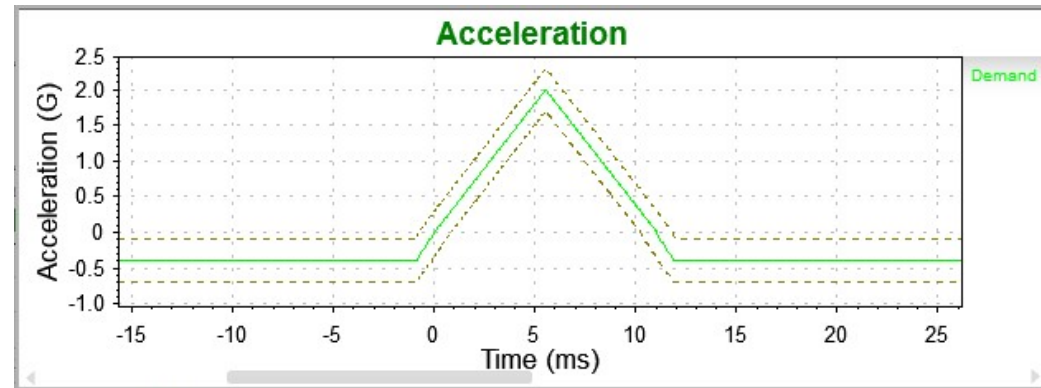
Classical Shock Frequency Response



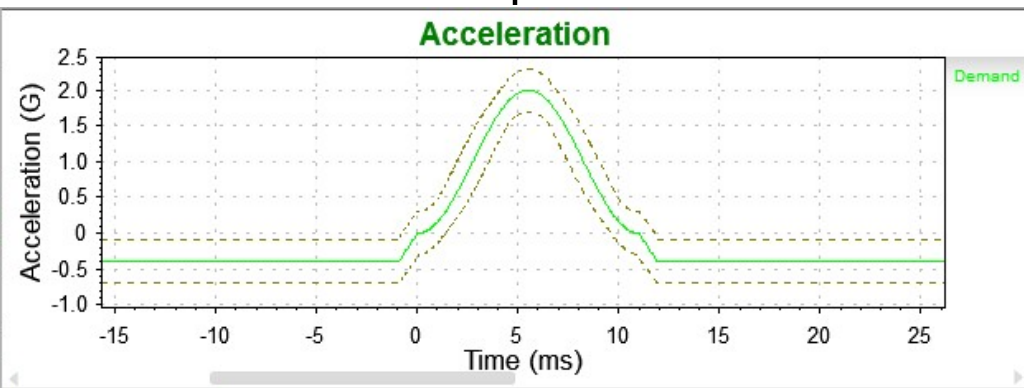
Other Pulse Types



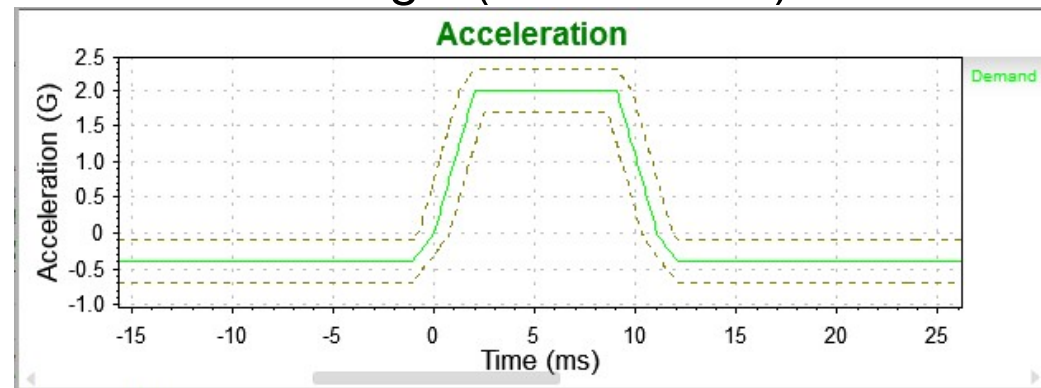
Square



Triangle (Crush Event)

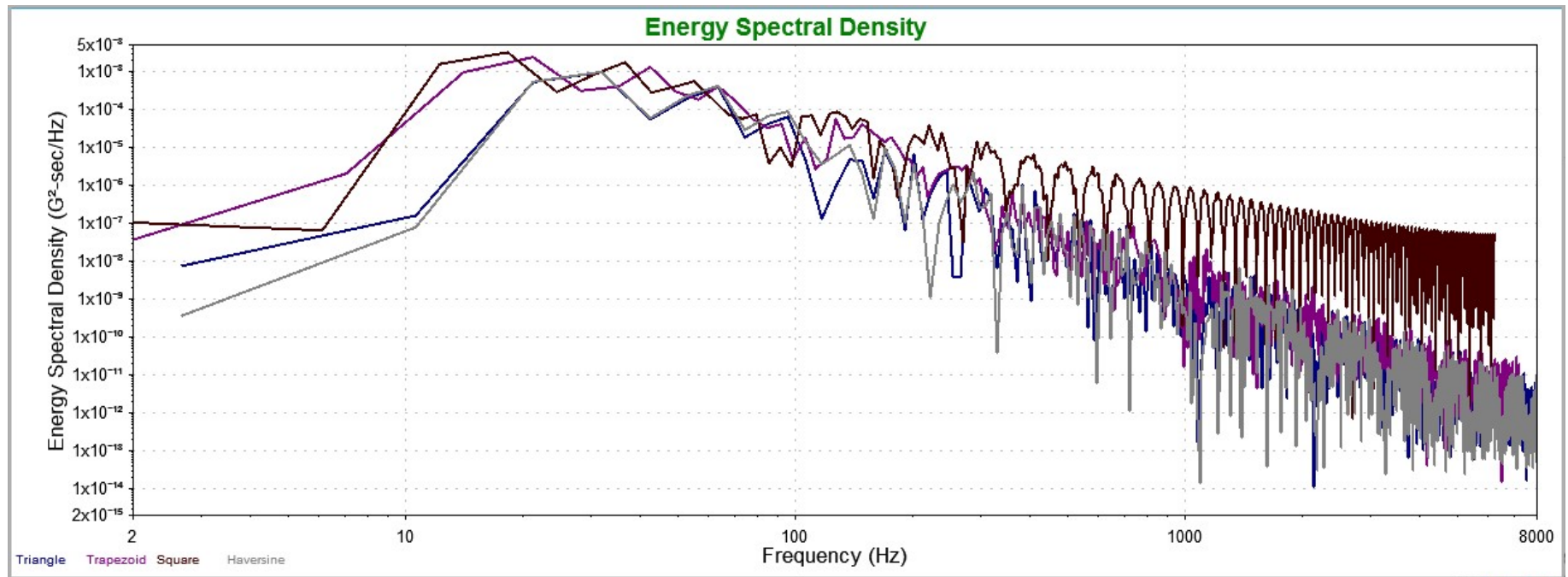


Haversine



Trapezoidal

Other pulse types



Any
Questions



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**THANK
YOU**

Gracias

Grazie

Mulțumesc

Merci

Danke

Gracias

Takk

Спасибо

Добре

Deku

Kiitos

shukria

Paldies

Takk

Arigato