THE FOURIER TRANSFORM OF A HALF-SINE PULSE

By Tom Irvine
Email: tomirvine@aol.com

December 14, 2010

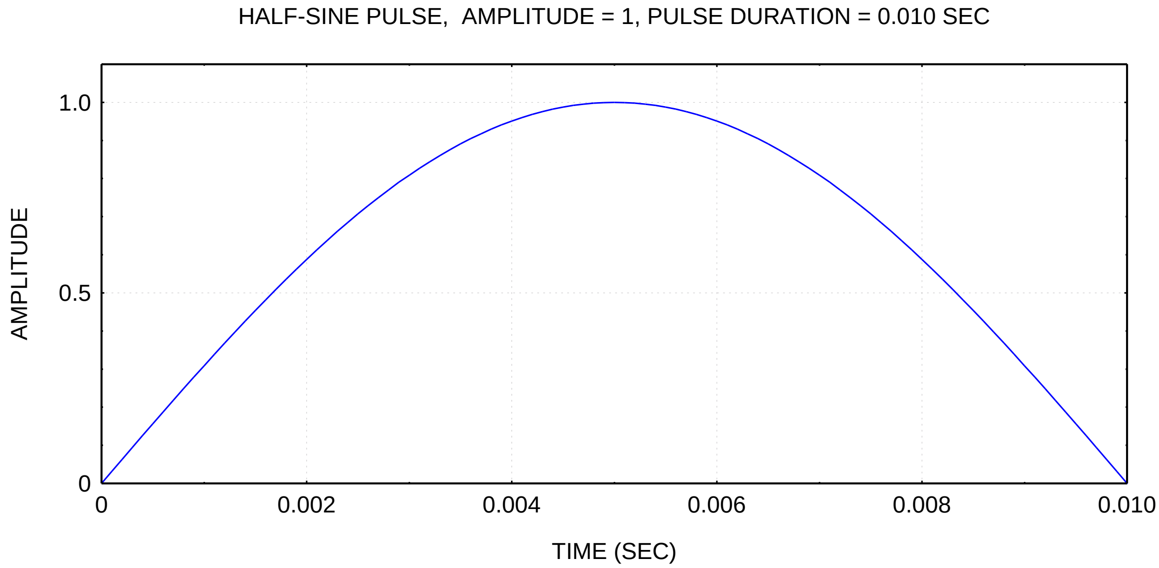

Figure 1a.

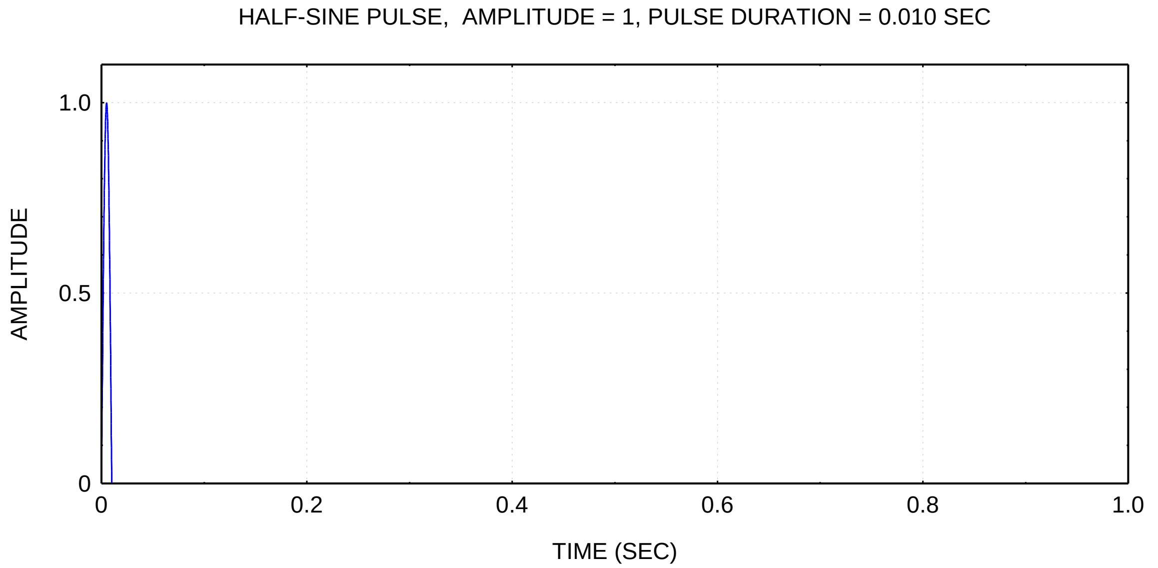

Figure 1b.

The half-sine pulse duration is 0.010 seconds. A post-pulse is added, with the amplitude set to zero, to extend the total duration to 1.000 seconds. This is done to increase the spectral resolution of the Fourier magnitude, shown in Figure 2.

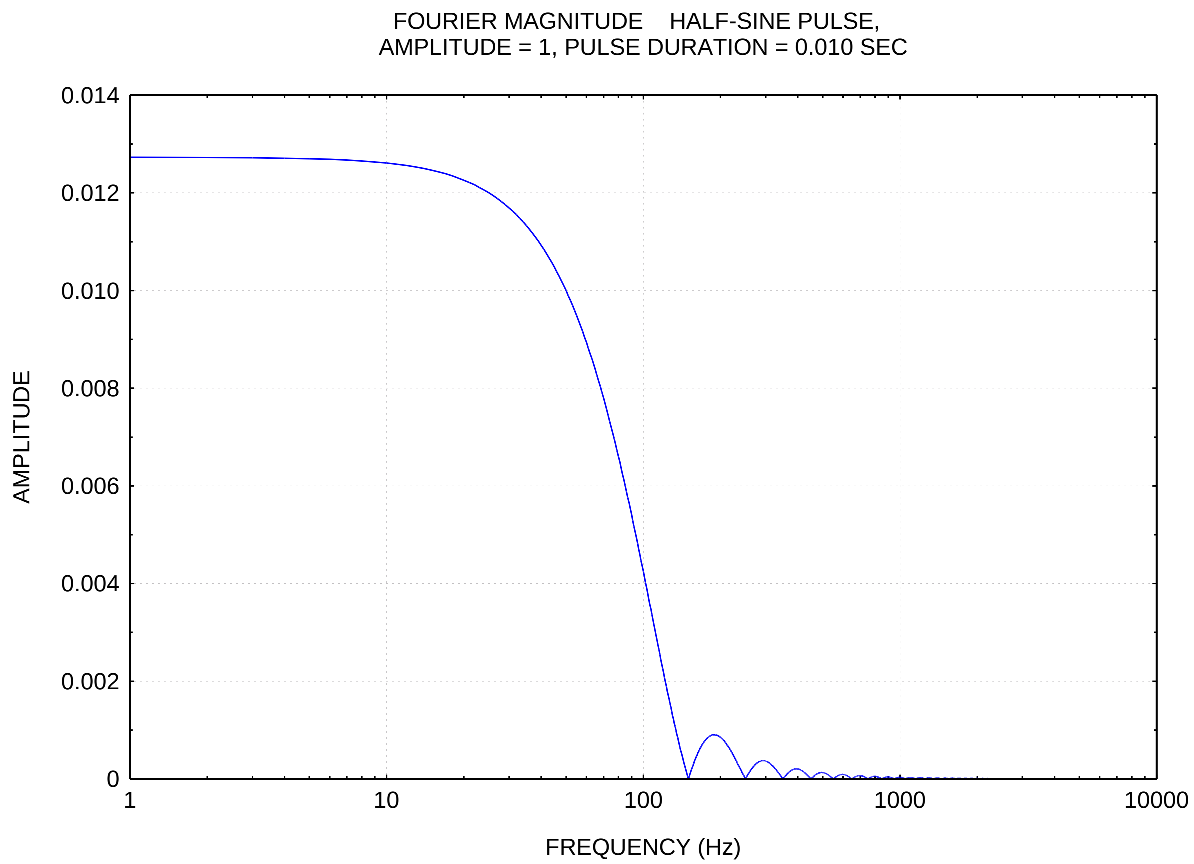

Figure 2.

The Fourier transform shows that the half-sine pulse has a spectrum of energy, with a roll-off near 20 Hz.

Thus, the 0.010-sec, half-sine pulse cannot be modeled as one-half of a 50 Hz sine function.

The Fourier transform of a pure sine function would be a single, discrete line, in a magnitude plot.

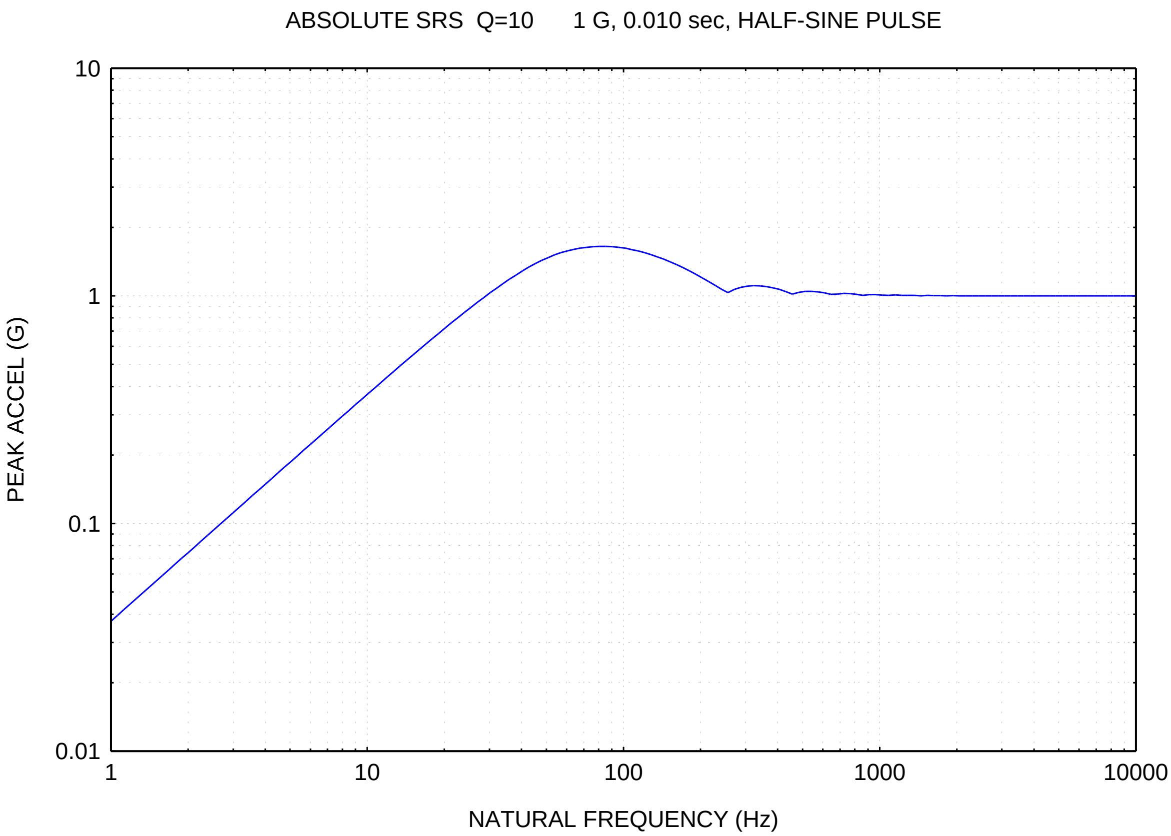

Figure 3.

Assume that the half-sine pulse represents the base acceleration to a single-degree-of-freedom system.

The corresponding shock response spectrum is shown in Figure 3.

The highest response is 1.65 G at 80 Hz. The time domain response of the 80 Hz system is shown in Figure 4.

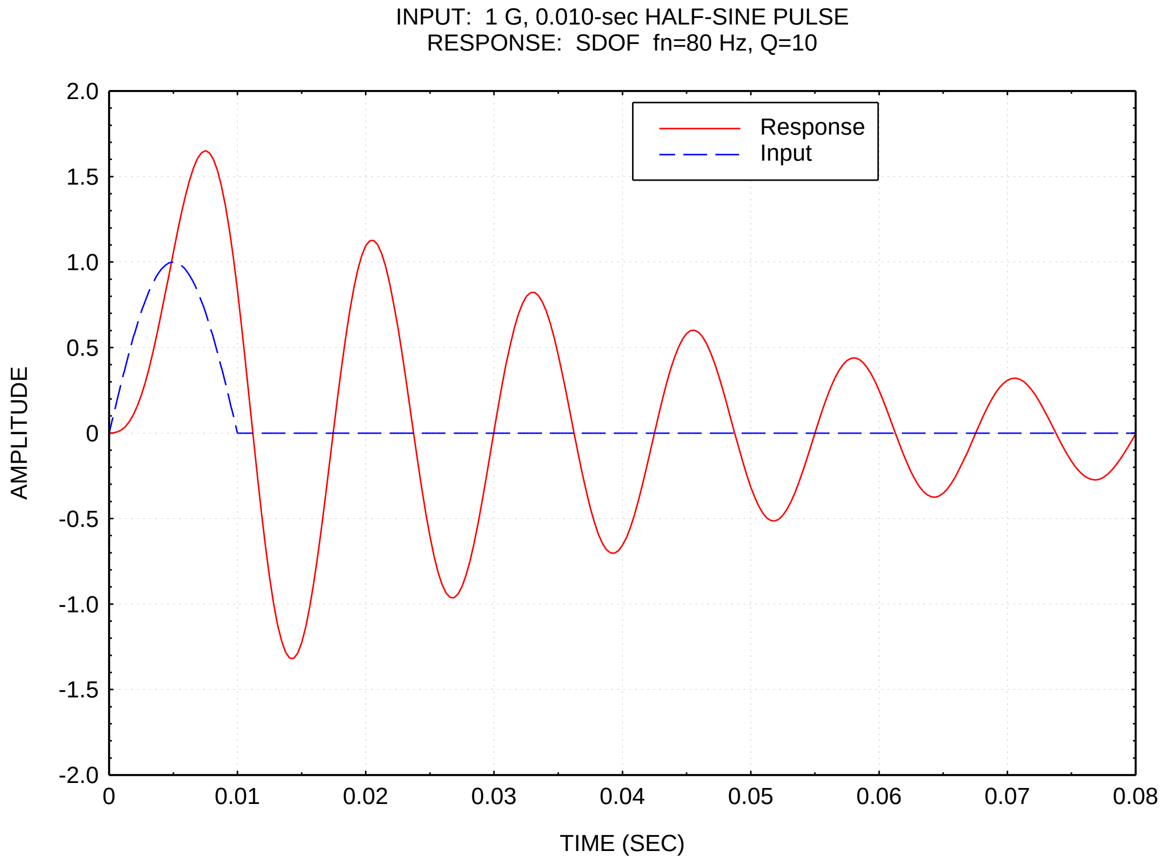

Figure 4.

The 80 Hz system has a delayed response during the first millisecond. The response then tries to quickly catch up to the input but overshoots it, resulting in dynamic amplification. The peak response occurs at 0.0075 seconds.

The response then slopes downward, still trying to catch the input, which abruptly ends at 0.01 seconds. The system has a free response thereafter.

One might expected a 50 Hz system to have a higher response than an 80 Hz system. But the 80 Hz system is more nimble, and can thus follow the input more closely.

A comparison is shown in Figure 5.

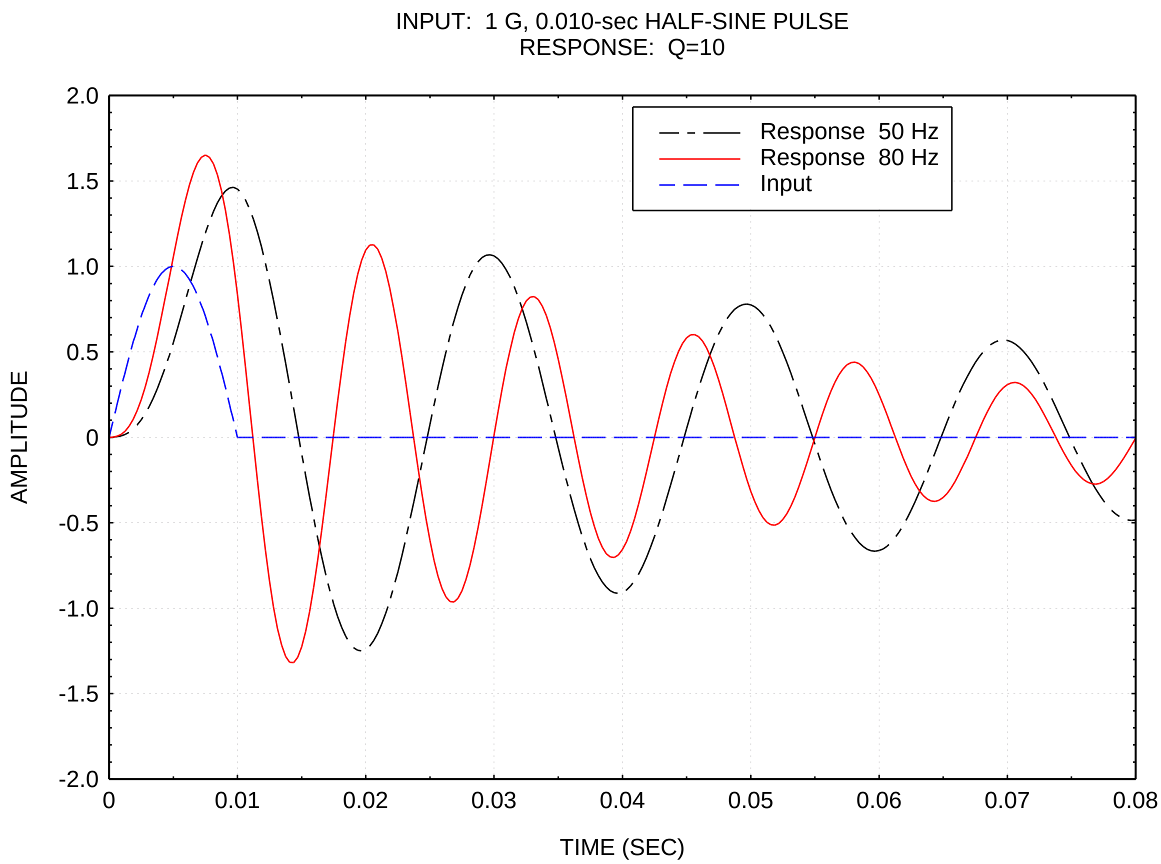

Figure 5.

<u>References</u>

1. T. Irvine, Response of a Single-degree-of-freedom System Subjected to a Classical Pulse Base Excitation, Vibrationdata, 1999.
2. T. Irvine, Introduction to the Shock Response Spectrum, Rev R, Vibrationdata, 2010.
3. T. Irvine, An Introduction to Spectral Functions, Rev B, Vibrationdata, 2000.