MODAL SPACE - IN OUR OWN LITTLE WORLD

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My accelerometer is not overloaded but my measurement is terrible. What could be wrong?
Some discussion of this is needed here.

OK – there can be many things that might cause this problem. The measurements can be contaminated by a variety of sources. Many different types of problems may be encountered in different situations. But in this particular case you have a very strange problem from the measurement that was provided. At first glance, the structure seems to be one that can be tested with little problem.

Let's start with a different structure and recreate the measurement problem that actually existed in your measurement system. For the structure here, a simple plate was instrumented with an accelerometer and subjected to impact testing. Three different cases will be shown to show what could have happened with the measurement.

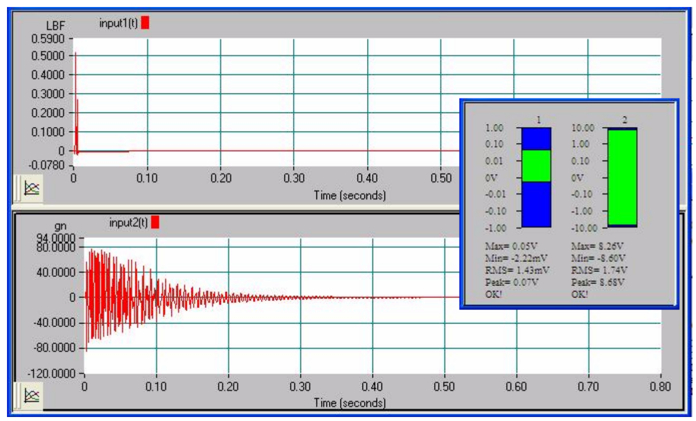

Figure 1 – Excitation (top) and Response (bottom) with Sensitive Accelerometer and Exponential Window for Case 1

Case 1 – Sensitive Accelerometer with Exponential Window

In the first measurement, an impact excitation was used. A very sensitive accelerometer was used and because leakage may be a problem, an exponential window was used for this measurement. Figure 1 shows the input excitation and the response from the accelerometer. Also shown in Figure 1 are the ADC range settings that resulted from the measurement. The measurement looks reasonable and there doesn't appear to be any problem with the time measurement.

However, looking at the frequency response function and the coherence in Figure 2, the measurement looks terrible indeed. The measurement has no real useful information anywhere in the frequency range shown. Clearly, this measurement is not good at all.

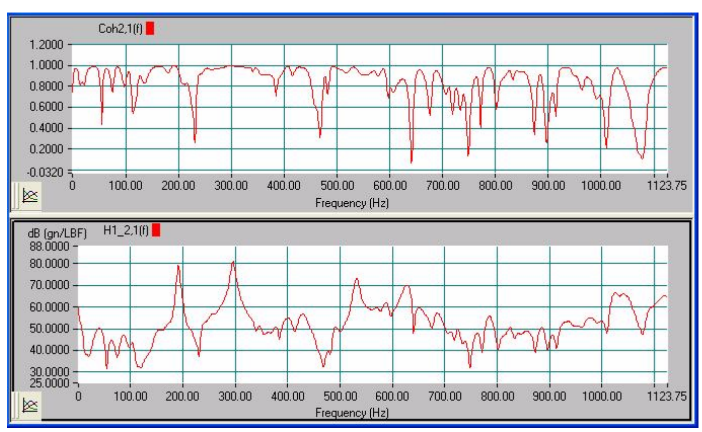

Figure 2 – FRF (bottom) & Coherence (top) with Sensitive Accelerometer and Exponential Window for Case 1

Case 2 – Sensitive Accelerometer with No Window

In the second measurement, an impact excitation was used again but no window was applied to the response window to see if there was any additional information that could be seen.

Figure 3 shows the input excitation and the response from the accelerometer. Also shown in Figure 3 are the ADC range settings that resulted from the measurement. There doesn't appear to be any overload with the time measurement.

Again, looking at the frequency response function and the coherence in Figure 4, the measure still looks terrible.

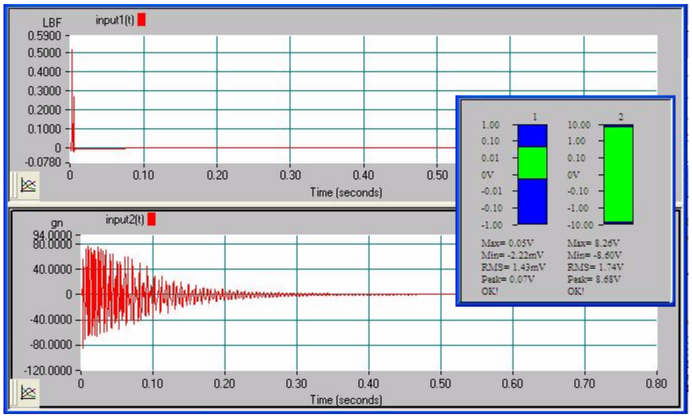

Figure 3 – Excitation (top) and Response (bottom) with Sensitive Accelerometer and Exponential Window for Case 2

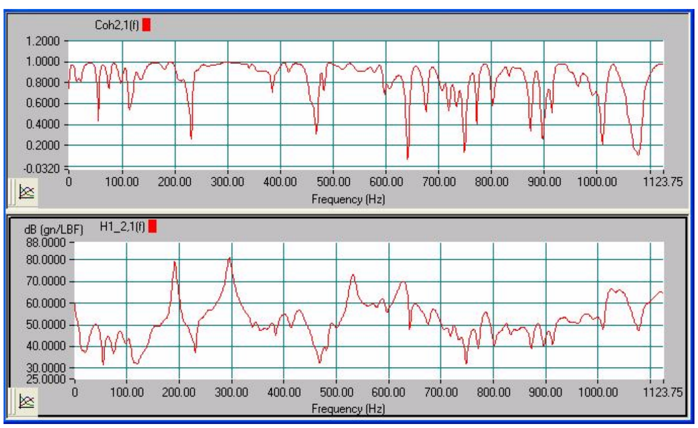

Figure 4 – FRF (bottom) & Coherence (top) with Sensitive Accelerometer and Exponential Window for Case 2

But looking at the time trace, the response does not appear to be what would be expected for a second order exponentially decaying system. What has actually occurred here is the accelerometer response was so large that it saturated the accelerometer response causing it to respond in a nonlinear fashion. During the first 0.05 seconds of time response, the system does not appear to respond in an exponential fashion. But the interesting part is that the total accelerometer voltage output was not greater than 10 volts and therefore did not overload the ADC of the acquisition system!

Case 3 – Less Sensitive Accelerometer with No Window

In the third measurement, an impact excitation was used again but no window was applied and a less sensitive accelerometer was used for the measurement. Now the time response in Figure 5 and frequency response in Figure 6 looks like what was expected.

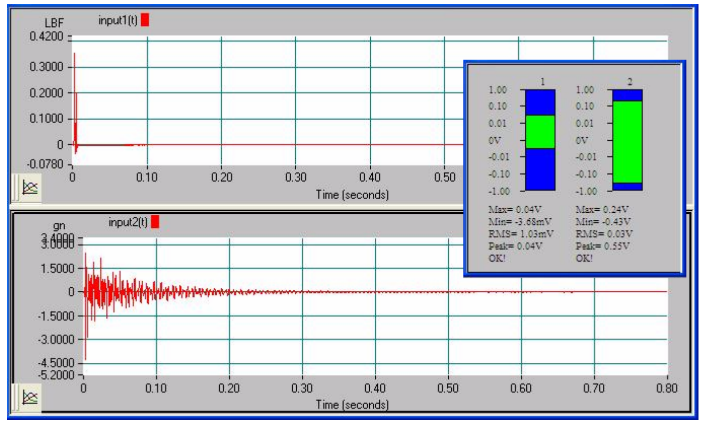

Figure 5 – Excitation (top) and Response (bottom) with Sensitive Accelerometer and Exponential Window for Case 3

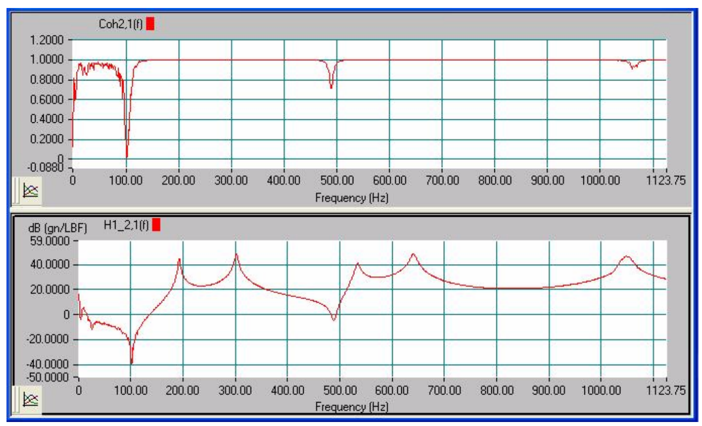

Figure 6 – FRF (bottom) & Coherence (top) with Sensitive Accelerometer and Exponential Window for Case 3

The problem in this case was that too sensitive an accelerometer was used for the impact test. While the FFT analyzer ADC did not overload, the accelerometer was saturated by the large response; this caused a response that was far different from the damped exponential response expected. So it is very important to look at all the various pieces of the time and frequency measurements made.

I hope that this sheds additional light onto this measurement problem. You not only have to worry about the measurement system but also the transducers used to make the measurement. If you have any more questions on modal analysis, just ask me.