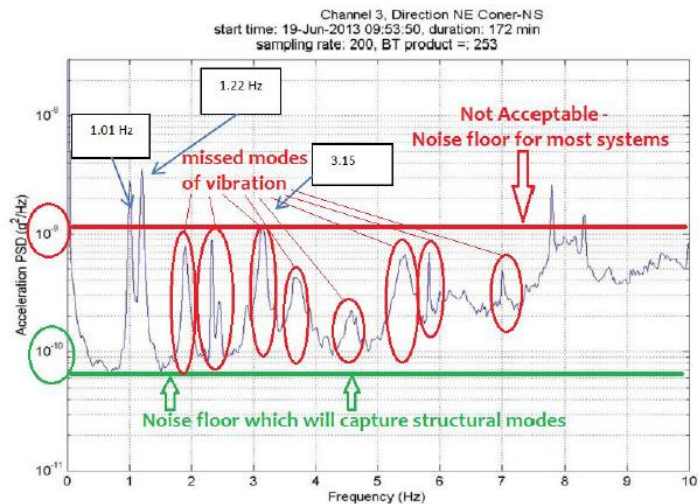




STRAAM Group's unique services - STRAAM Group has developed a unique Structural Monitoring platform and has the unique skill set needed for the development and practical use of the platform. In a market crowded with companies who offer 'Structural Health Monitoring', there are very few who understand advanced structural dynamics and no one who has made the investment to build a platform to capture dynamic measurements as well as other measurements and process them in real time for immediate analysis consistent with STRAAM's advanced dynamic analysis techniques.

Nuance – The theory that all structures are moving all of the time is critical to understanding the STRAAM approach to advanced structural dynamics. We have developed our platform to be able to take dynamic measurements during very low amplitude conditions. Specifically, for bridges when there is no traffic. Since the structures are always moving, the dynamic properties are able to be captured with the right equipment and the right algorithms.



STRAAM made a significant investment to build the platform so that dynamic parameters could be measured at any time. On the spectrum on the right, we show a red line ($1 \times 10^{-9} \text{ g}^2/\text{Hz}$) where some of the better accelerometers can capture response data. The green line shows where STRAAM's platform resolves to which is $3 \times 10^{-10} \text{ g}^2/\text{Hz}$. This is more than an order of magnitude more sensitive than the green line (the Spectrum is a logarithmic scale). The spectrum provided is data from a real structure. The actual structural resonances shown, and circled in red could not be measured by the system resolving to 1×10^{-9} . To achieve this added 30 to 50 times greater sensitivity, it requires a very advanced understanding of electronics. It also requires the use of the proper sensors and to combine them with the electronics that have an exceptionally low noise floor. Also needed are filtering algorithms to capture the structural resonances from inherent electronic noise and to avoid 'ghost' resonances which can occur when the data is not processed correctly. We have put all of this technology into our hardware and our cloud-based monitoring system.

For those who do not understand this detail, they cannot resolve the dynamic response in the range that STRAAM can. Such precision allows an early identification of structural problems and weaknesses.

Value – After a baseline on any structure is captured, being able to compare the baseline with the most recent data very often needs to occur during the most inopportune times. For instance, after a hurricane, bridge owners may not feel it is wise to allow traffic on a bridge until a measurement is taken. Therefore the system measuring the structure, needs to be capable of measuring the response in real time during very low levels of excitation. And the response needs to be clear enough to make the comparison with the baseline. It was for this critical application that the STRAAM Platform was developed. Additionally, it allows for the most efficient measurements by limiting the amount of data, since all the low amplitude data helps create a valid spectral response.

Nonlinear response – Those with a limited understanding of structural dynamics will not be able to provide a detailed analysis of the non-linear behavior of structures. The non-linearities of a structure are very important to identify failure modes and quantify damage to a structure. The STRAAM platform was designed to provide non-linear analysis of response data for analysis.

Value – As structures degrade, there are often structural mechanisms that engage and release at various amplitudes. Understanding how to look at a structure's response at various amplitudes for non-linearities is essential to a good detailed analysis.

Systems Identification – In addition to taking the measurements, it is essential to quantify exactly what mode of vibration each resonance correlates to. STRAAM provides detailed systems identification as part of the analysis. If the measurements did not capture all of the frequencies of resonance due to poor electronics, the systems identification process will be flawed and modes will be missed. This can often happen with the lower frequency modes of vibration since they could have lower amplitude response (below 1×10^{-9}).

Business Model – STRAAM offers a license business model to provide its partners to have access to the advanced technology in a manner where they can reduce costs and can respond very quickly to emergencies as needed. STRAAM provides training on the technology so licensee's become integral to the solutions and both parties

Questions to ask those who provide dynamics assessment services:

- 1) What level do you resolve acceleration information to?
- 2) How do you do non-linear dynamic analysis? Why did you choose that method?
- 3) When doing systems identification, how do you validate the modal response?