**Relationship between Structural Dynamic Properties and Acoustic Emissions**

It is unclear the relationship between natural frequency and acoustic emissions. The shift in natural frequencies result in a shift in the acoustic emission spectra captured from a given source. This is demonstrated through by changing the effective length of an aluminum plate, while keeping a fixed acoustic emission setup and source. I have yet to see AE literature that delves into this topic and think it’s worth thinking about. I hypothesize that acoustic emissions, the response of the system to a damage event, are dependent on the dynamic properties of the structure.

**Damage Accumulation Impact on AE in SiC / SiC Minicomposite**

In the composite world, it is well known that the natural frequency of a structure is influenced by the presence of cracks. Additionally, the speed dramatically reduces in a composite -> up to 50%. It is unclear what exactly drives the reduction in speed; it is hypothesized to be correlated to the changing effective modulus. A changing stiffness of the system would imply a shift in the natural frequencies of vibration for the structure. In other words, a given event at the start of a test will have different frequency spectra than an event at the end of a test.

Investigating this is important because machine learning relies on pattern recognition; in the situation where a given source emits a different signal due to the change in the frequency response of the material. This begs the question; are these changes in signal significant, and if so can ML framework be used effectively in spite of these changes.

As ML algorithms, became increasing popular in nod-destructive evaluation of materials, particularly for addressing the task of damage mechanism identification. Careful consideration must be given to the grouping of signals. i.e. signals clustered together represent a given mechanism. To answer this question, we will consider how a signal may change over the course of a test.

**Robustness of ML Framework to Experimental Influencers of AE**

An ML framework that classifies AE signals in a structure must be robust to common experimental variable if it will ever see use in industry. The benefit of AE is that it is convenient, i.e., not geometry limited, easy to couple a sensor to equipment. It can be applied to any shape, rather than a focus region of the component. This quick-and-dirty approach, however, has the drawback that AE data from experiment to experiment is not repeatable. It does beg the question: how well a framework can generalize across these different influencers. For instance, if the geometry of the structure is changed, the reflections change (in addition to the natural frequencies) can AE remain valuable as a source identification.

**Multi-modal Damage Characterization – Experimental Modal Analysis and Acoustic Emission**

Experimental modal analysis is a parallel field for determining the dynamic characteristics of a structure, mode shapes and their natural frequencies using linear system theory and eigen values. Interestingly, they use a hammer, with a force transducer to measure the input frequency spectrum, then measure the output spectrum at different locations to characterize the structure. This is interesting, because the pencil-lead break can be thought of as applying an impulse to the system ( maybe it doesn’t have a flat frequency input and is centered around a specific frequency ). Can shifts in natural frequency and acoustic emissions be used in conjunction to better characterize damage? Experimentally, is it possible to even capture higher frequency modes w/ DIC or Laser Vibrometry? What about if something were to impact a plate and stick, like a magnet.

**High-Temperature Acoustic Emission Testing of SiC/SiC Composites**

Eventually, these composites will be in service in high-temperature environments. Community would benefit from having more work done on acquiring AE in these settings.