Blast Induced Shock Response Spectrum

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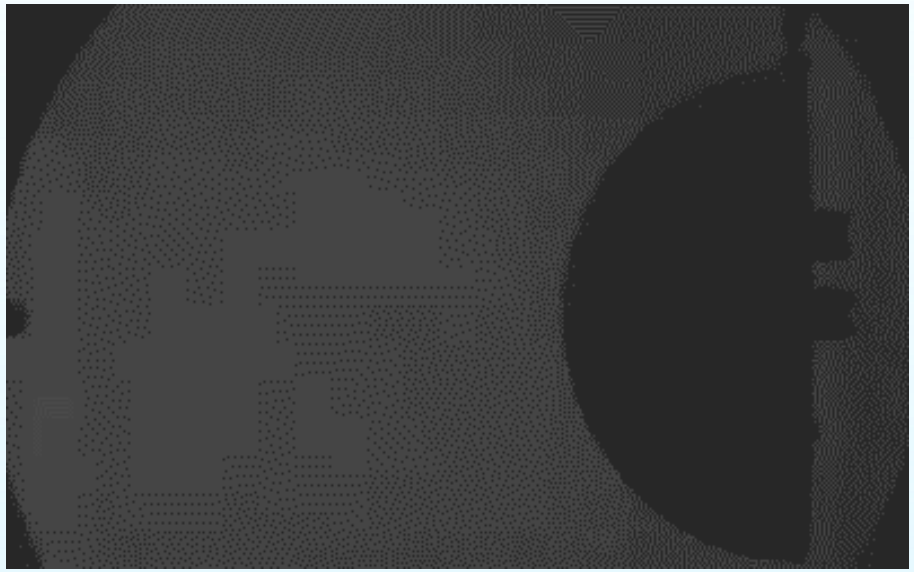
Introduction and Motivation

The SRS is calculated using a recursive method determining the response a series of single degree of freedom oscillators, of differing natural frequencies, would have to the collected acceleration time history. Shock response spectra are a measure of frequency responses of structures to an impulse load. SRS are typically measured through accelerometers attached to a structure subject to impact tests.[1] An explosive charge here is used to create a tunable load for a given SRS in a structure. The hemispherical shell and plates response is explored for varied explosive loads.



[1] Kelly, D. and Richman, G. “Principles and Techniques of Shock Data Analysis” 1969

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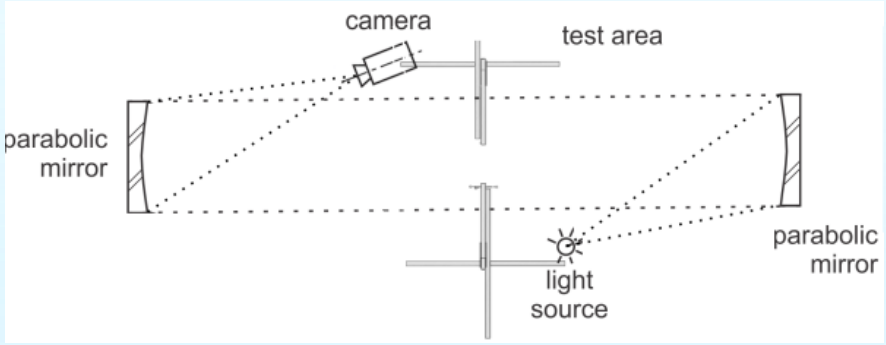
Approach

- Structural responses are induced by blast loading using 1 gram charges of Pentaerythritol tetranitrate (PETN).
- Measuring responses are done by accelerometers located at varying locations and orientations on the target.
- Highspeed imaging of the tests are done using schlieren imaging



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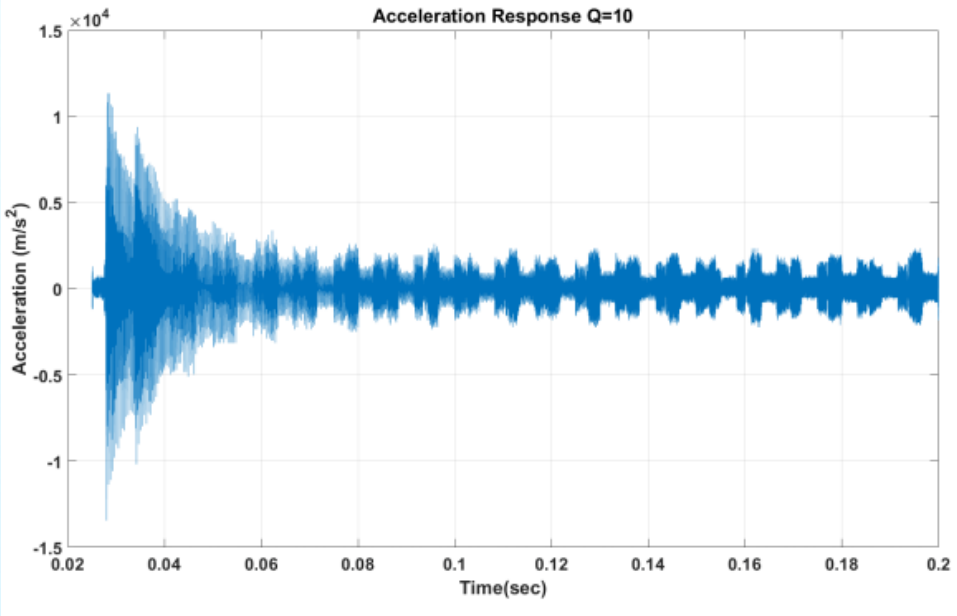
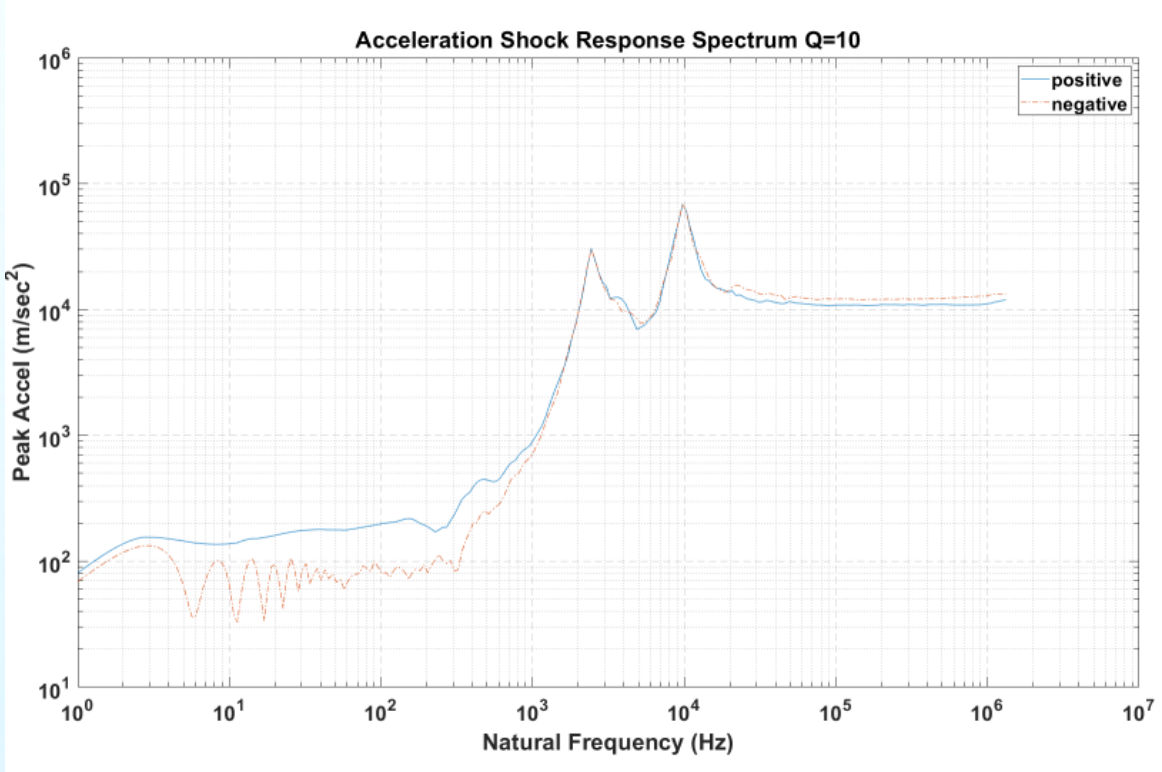
Current Status and Results

- The collected accelerometer data is processed using the Kelly-Richman SRS algorithm.
- The following acceleration time history plot produces the shown SRS on the right.





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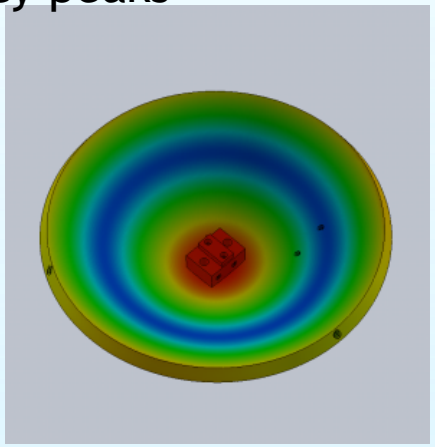
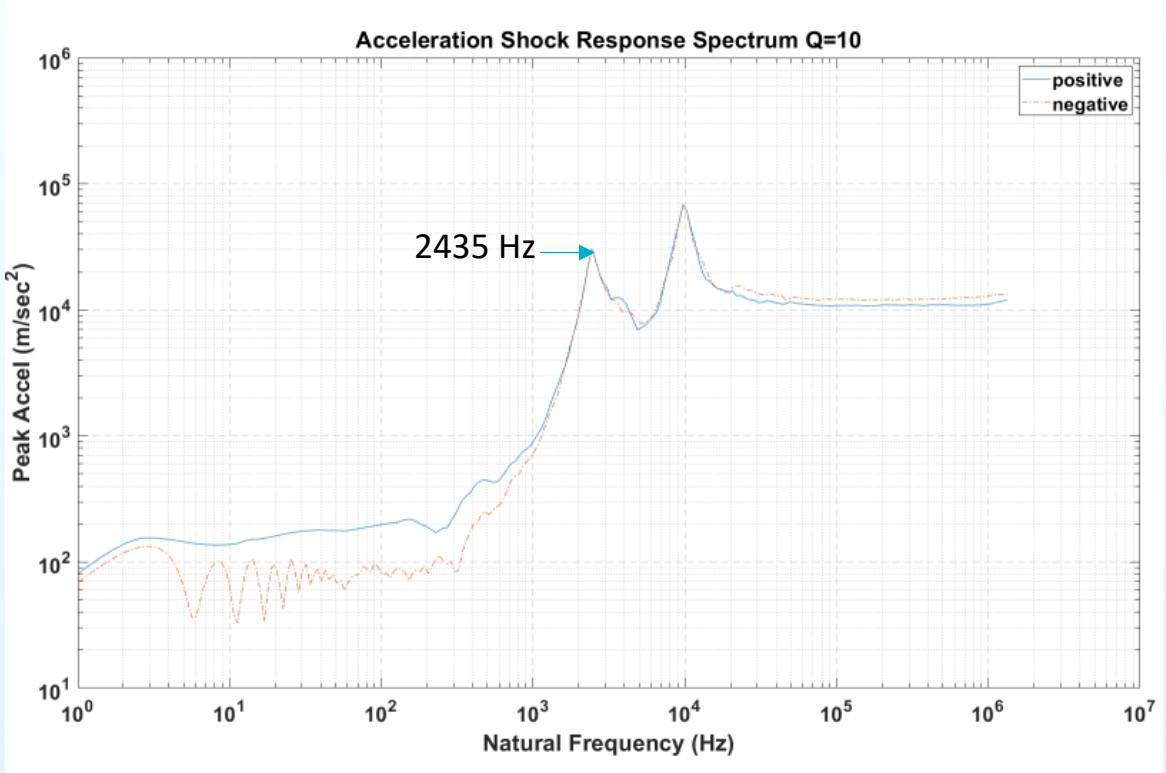
Current Status and Results

- Animation shown corresponds to a resonant mode at 2541 Hz using Solidworks 2020 Simulation module.
- The relation between modal frequencies and SRS frequency peaks collected at locations of deformation is currently being explored.





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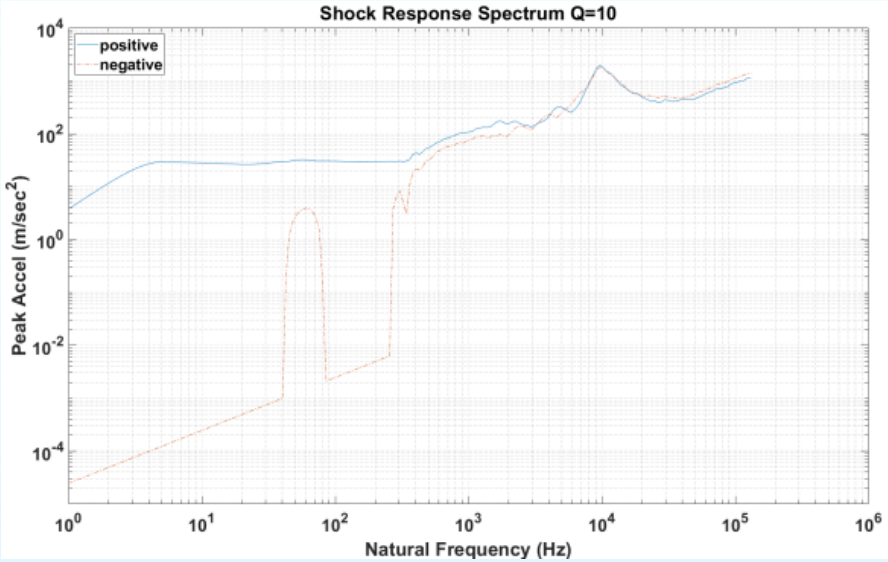
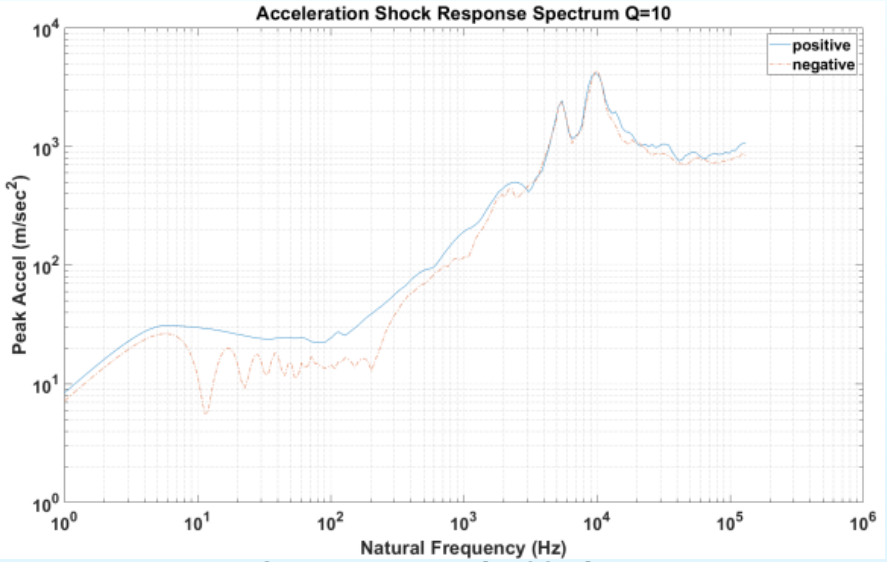
Impact of Work

- SRS testing on a small scale such as this allows for the tuning of the blast load by varying the distance between the explosive charge and target.
- The novelty of this method allows for an ease of exploration into the multiple data collection methods, such as Direct Image Correlation (DIC) and Photon Doppler Velocimetry (PDV).



6.46 cm standoff distance



4.12 cm standoff distance

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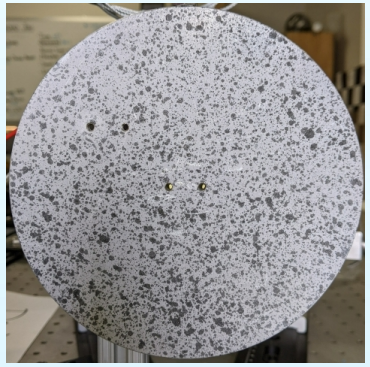
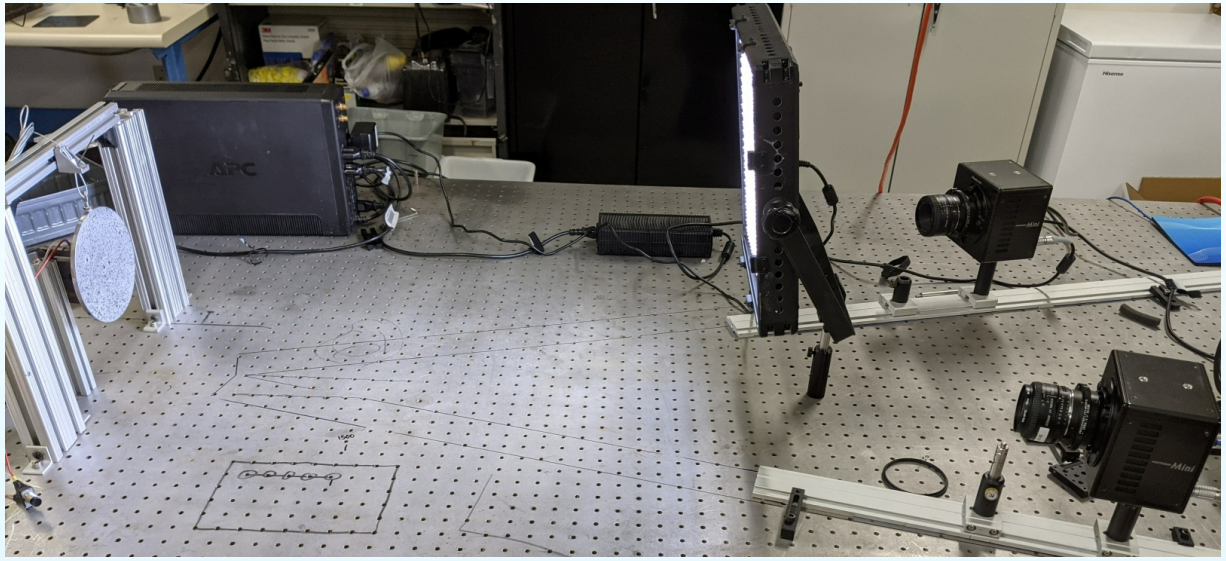
Next Steps and Future Work

- Currently performing preliminary tests utilizing Digital Image Correlation (DIC) as a method to measure material deformation of the target.
- Currently exploring to add Photon Doppler Velocimetry as another method of response measurements.
- Resulting acceleration data and SRS of PDV, DIC and accelerometer will be compared between each.
- Transitioning experimental data to Sandia for comparison with their modeling and simulation efforts.





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