Impact Testing & Pyrotechnic Shock Modeling
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Aim: To develop a system level method to quantify the effect of specific variables on the shock response spectrum

Introduction

Communications satellites are often equipped with sensitive electronic components and pyrotechnic devices used for stage separation and/or peripheral deployment. To ensure proper function, the survivability of these electronics must be tested against comparable force and acceleration levels.

Year One Objectives

- *Design and fabricate a versatile physical testing apparatus*
- *Develop analytical computer models to simulate tests*
- *Evaluate methods to tune fixture to achieve different SRS responses*
- *Identify trends in test results*
- *Compile data for future reference*
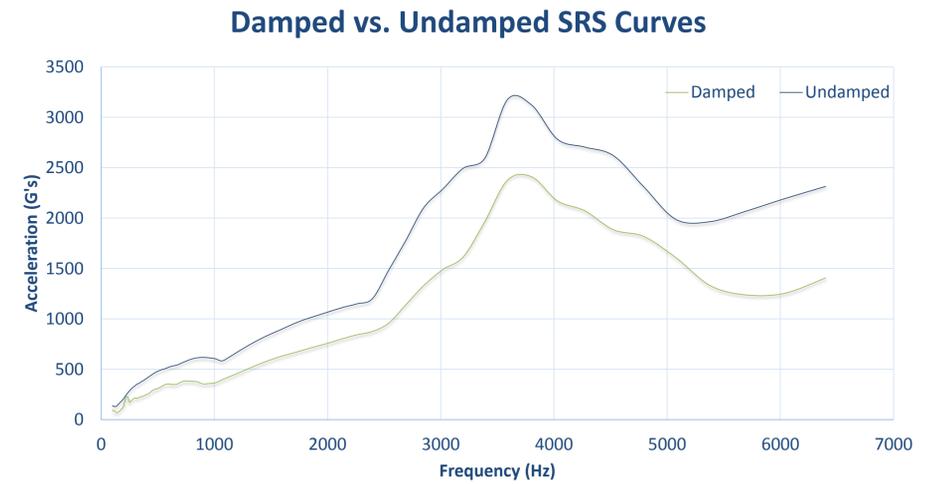
Variables of Interest

- Test Article Location
- Hammer Impact Location
- Hammer Tip Size – 4 sizes; 0.75" up to 1.875"
- Plate Boundary Conditions
  - Damped vs. Un-damped
- Modal Tuning Bands
 - Connects peak nodes to anti-nodes
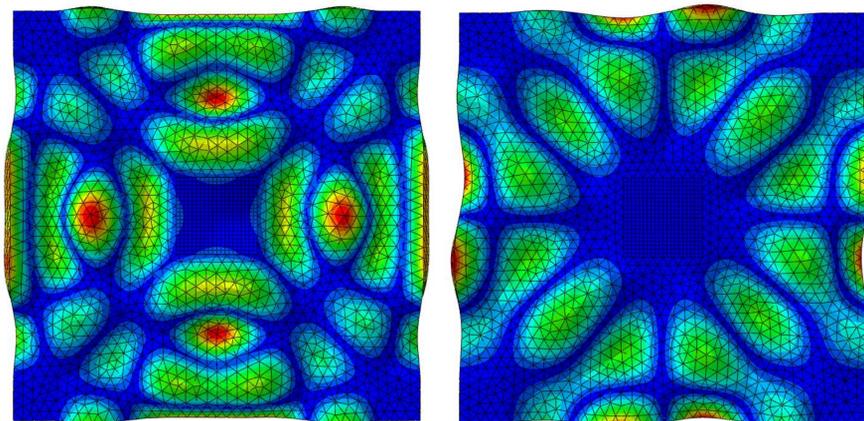
Mass participation data extracted from Abaqus CAE. High mass participation (red area) is observed at a certain frequency of vibration. This is a characteristic that can be "tuned". Left: Mode 40 @ 902.79 Hz. Right: Mode 66 @ 1501.3 Hz.
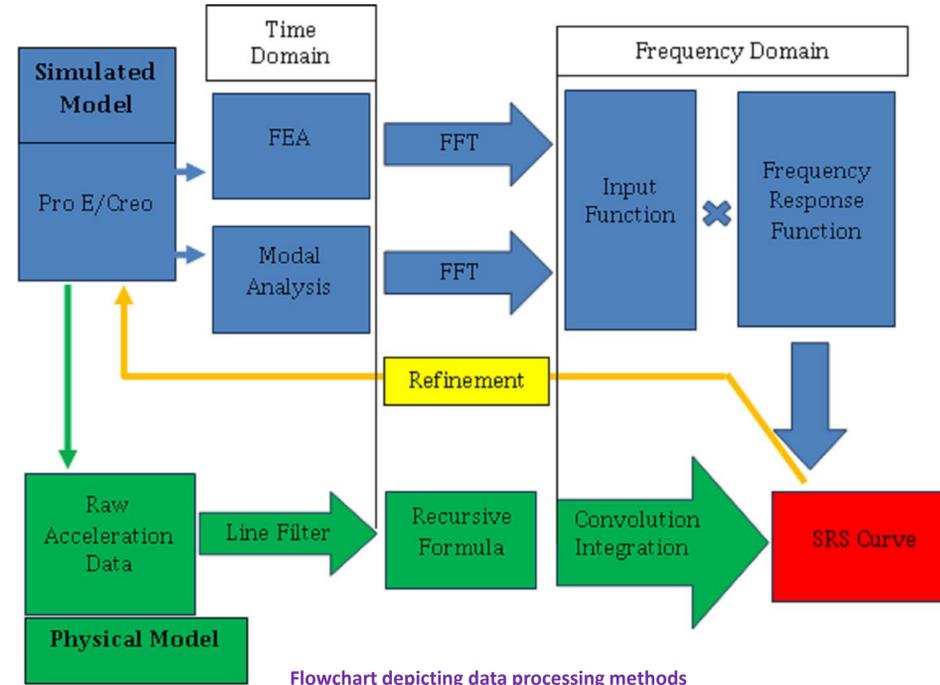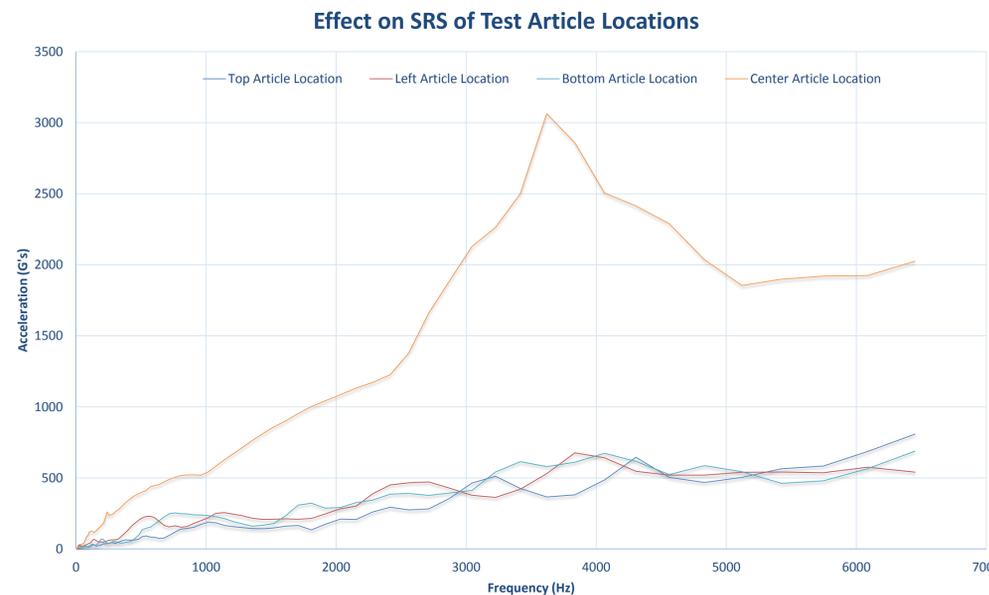

Flowchart depicting data processing methods

Effect on SRS of Test Article Locations

Comparative plot of four total test article locations. Noticeable shift in amplitude as well as shape of curve (essentially flattened).

Damped vs. Undamped SRS Curves

Comparative plot of two resulting SRS curves for damped vs. un-damped boundary conditions of the large fixture plate

Effect on SRS of Strike Locations
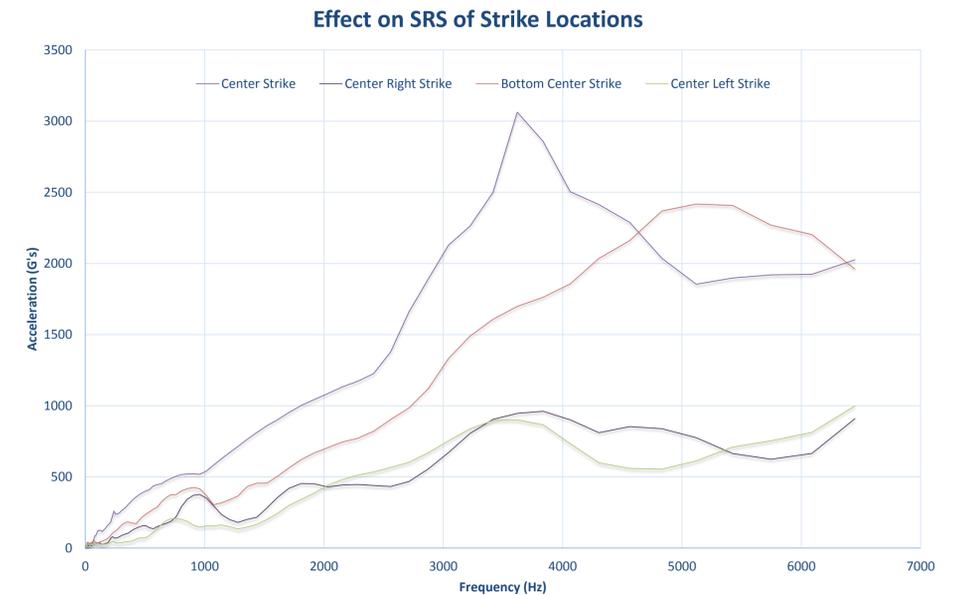
Comparative plot of four total strike locations. SRS plots show shifts in amplitude as well as peak frequency

Future Work

- Iterative testing, documentation, trend identification
- Year two testing: 5000g+ acceleration, 10kHz frequency range
- Added variables: Multiple test articles, varying hammer weights, rigid chassis fixation, alternative plate mounting
- Automated hammer adjustments
- Impact force sensors, pressure transducers
- Bearing based hammer arm pivot
- Data processing automation

Team Website: eng.fsu.edu/me/senior_design/2015/team15