SAND2015-10626PE

Effect of Internal Acoustic Modes on Response of a Hollow Structure

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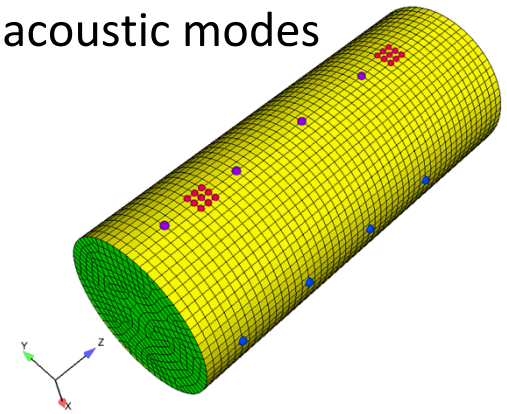
ACS597c – Computational Acoustics

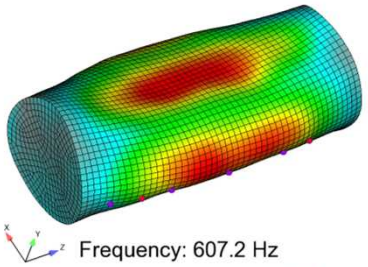
Are Dynamic Response Predictions Affected by Internal Acoustic Modes?

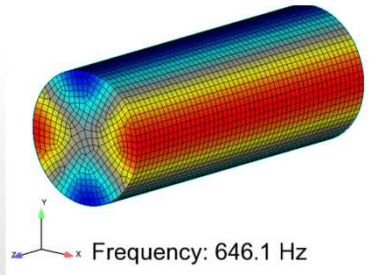
- Typical structural dynamics models used for assessing response to dynamic environments do not include an acoustic component
- If the internal acoustic volume is included and coupled to the structure, how much are response predictions affected if:
  - The acoustic modes are not well-matched to the structural modes
  - The acoustic modes are well-matched to the structural modes
- Model Setup:
  - Simple Empty cylinder with thick walls
  - Dimensions chosen to put structural modes near acoustic modes
  - Forced at two small contact patches
  - Response measured in- and off-axis
  - Cylinder: 1m long, 0.2m radius, 3 cm thick wall
- Acoustic Component:
  - Sound speed tuned to match structure modes
  - C0 = 265 m/s matches ovaling modes

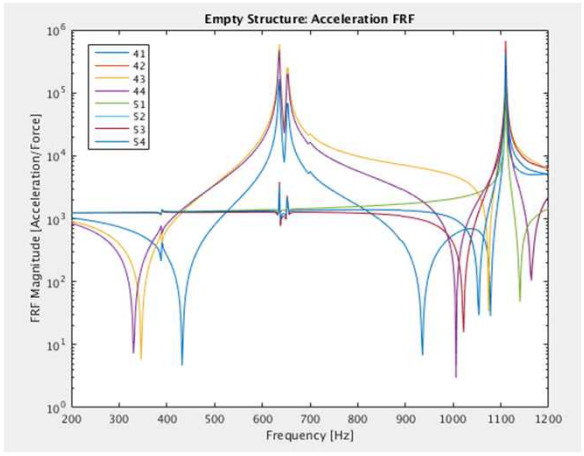


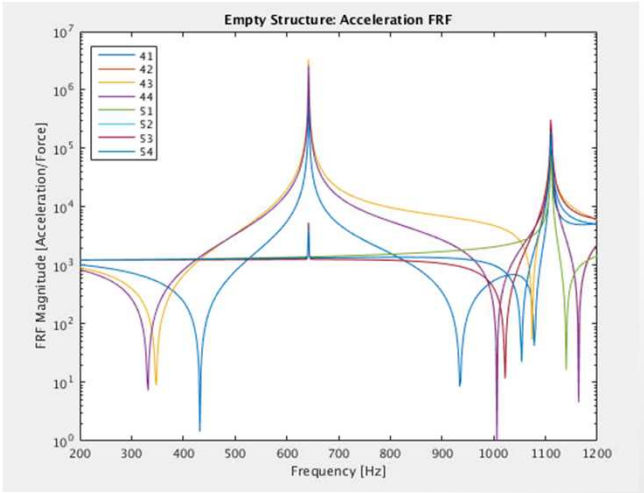
Results

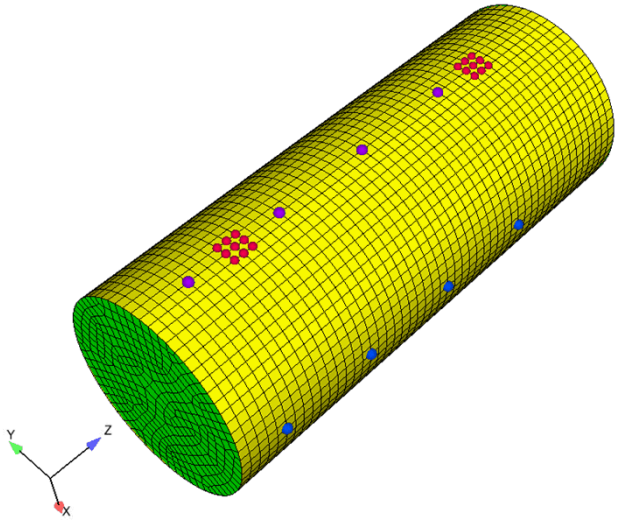
- When acoustic modes are aligned (shape and frequency) with structural modes, structural response is significantly affected
- Model predictions performed with an empty structure will over-predict response at resonance and will under-predict response in the vicinity of resonance due to the increased bandwidth in the coupled case where the acoustic cavity acts like a tuned absorber for the structure

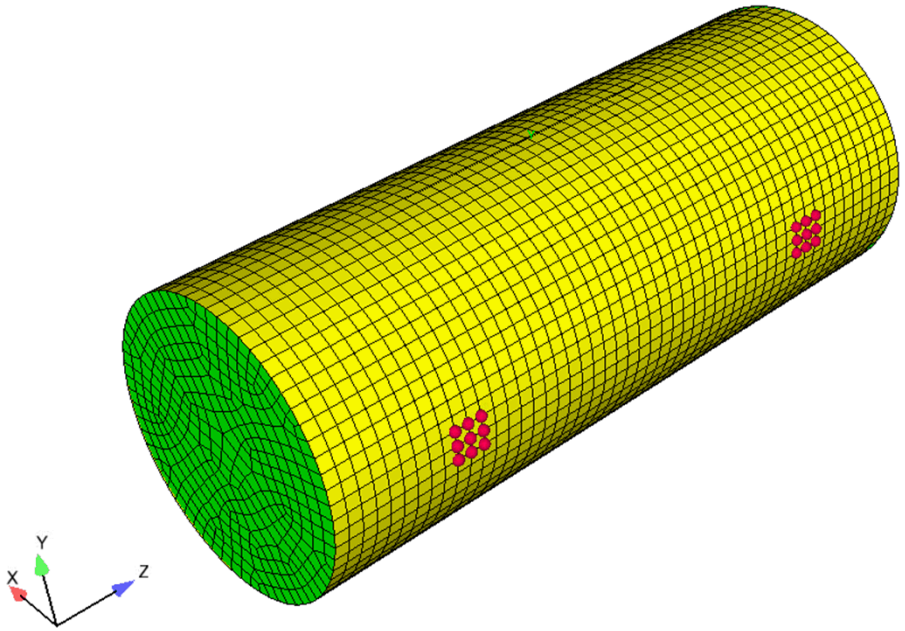









Y
Z
X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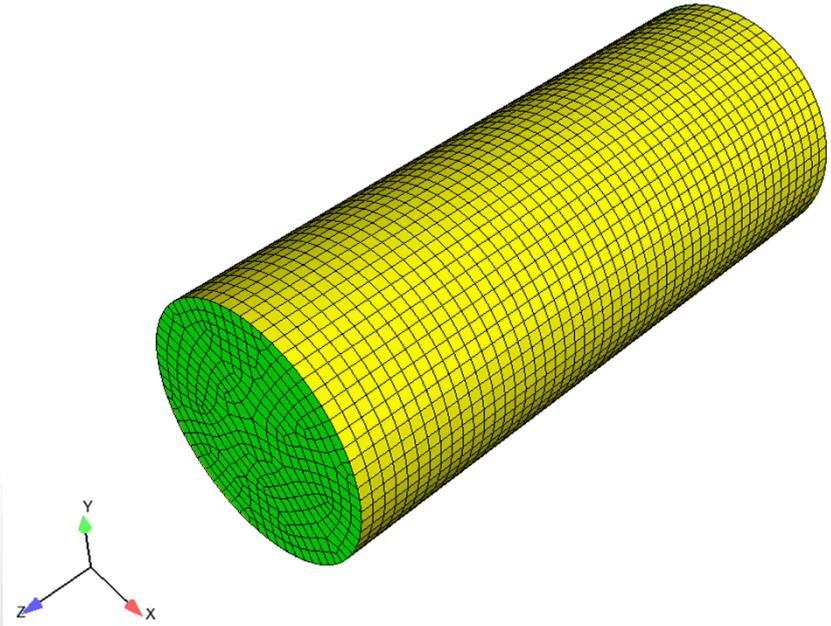
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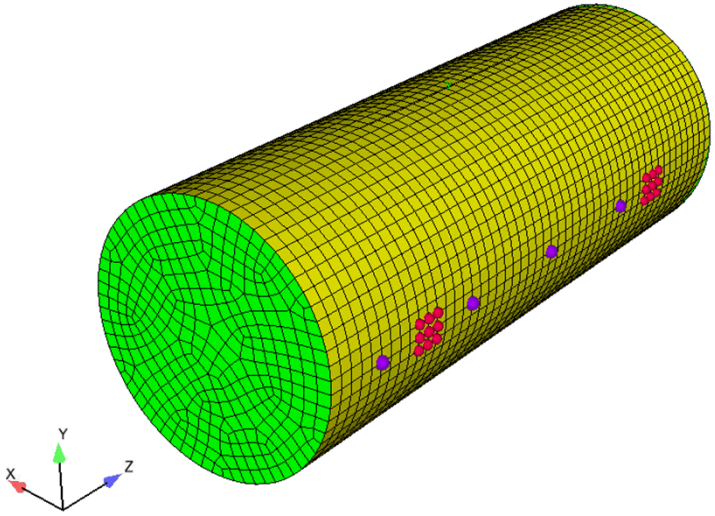
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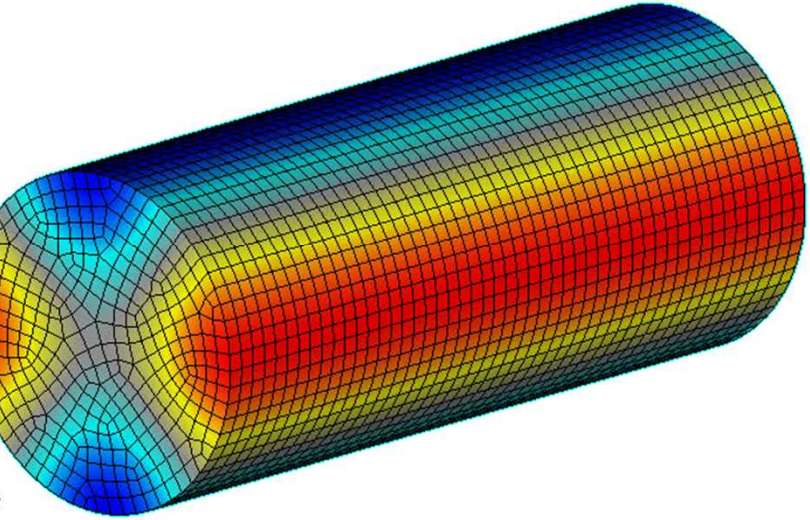
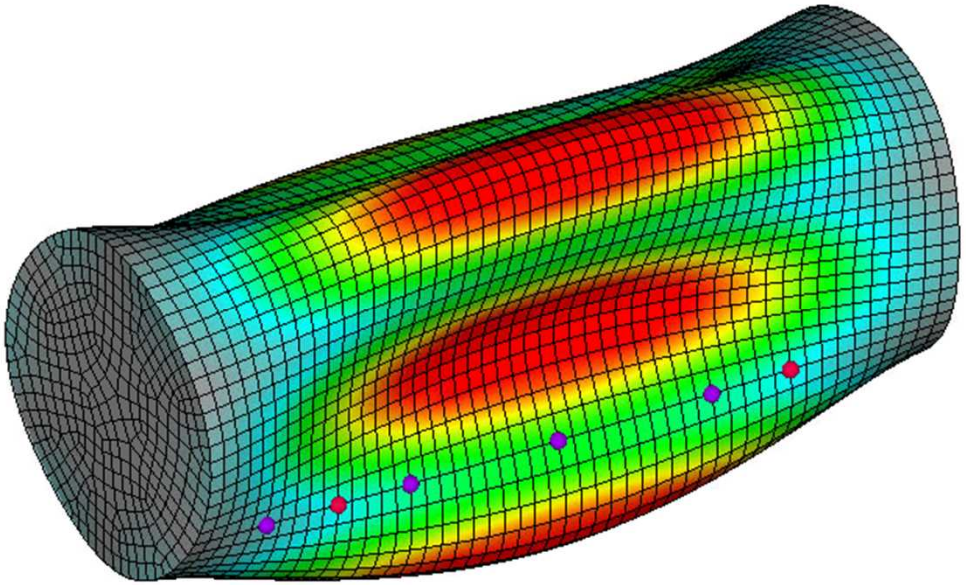
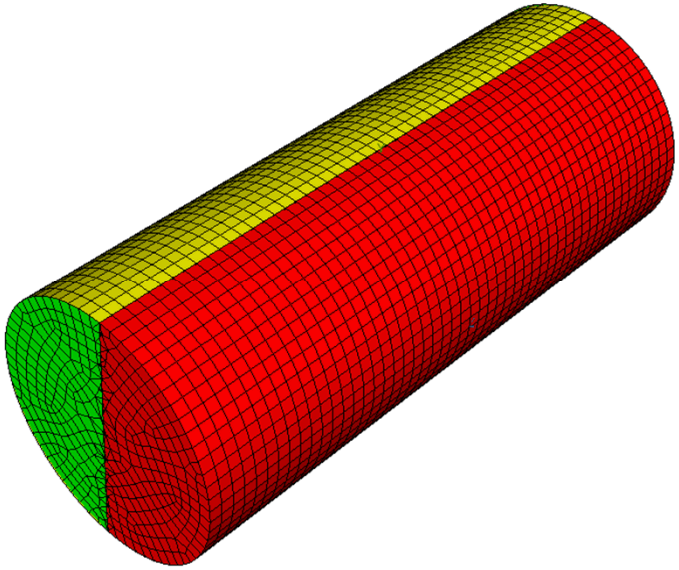
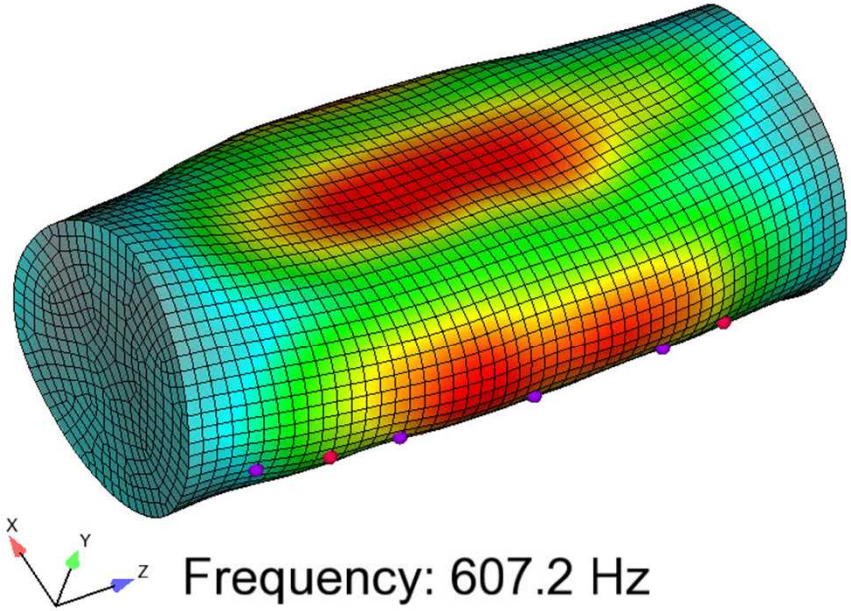


Frequency: 646.1 Hz



Frequency: 1455.9 Hz





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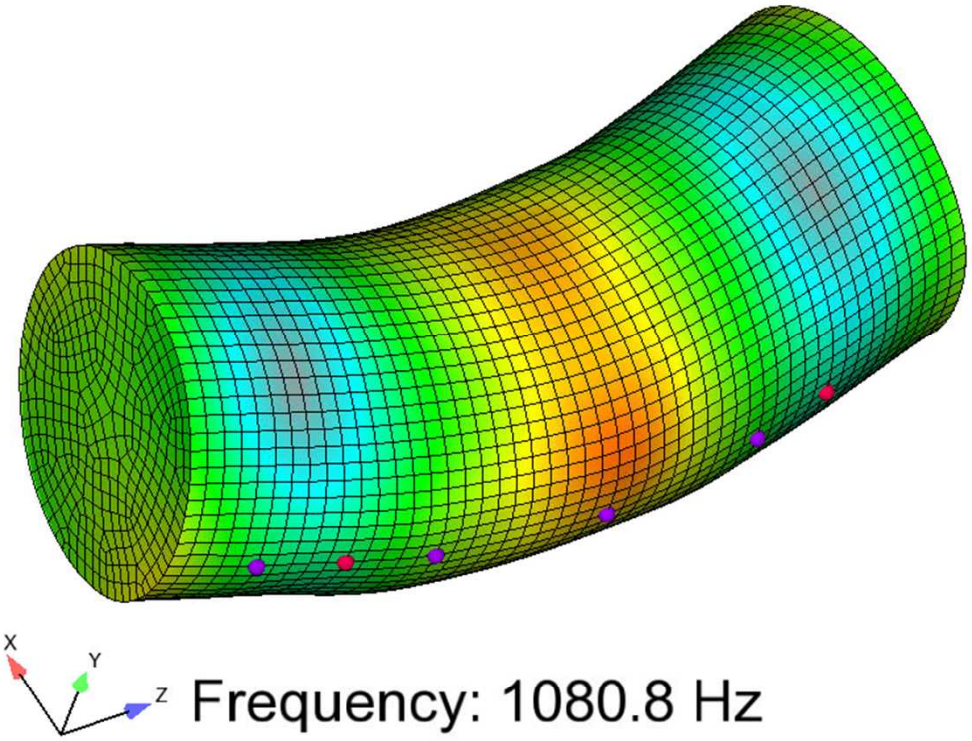
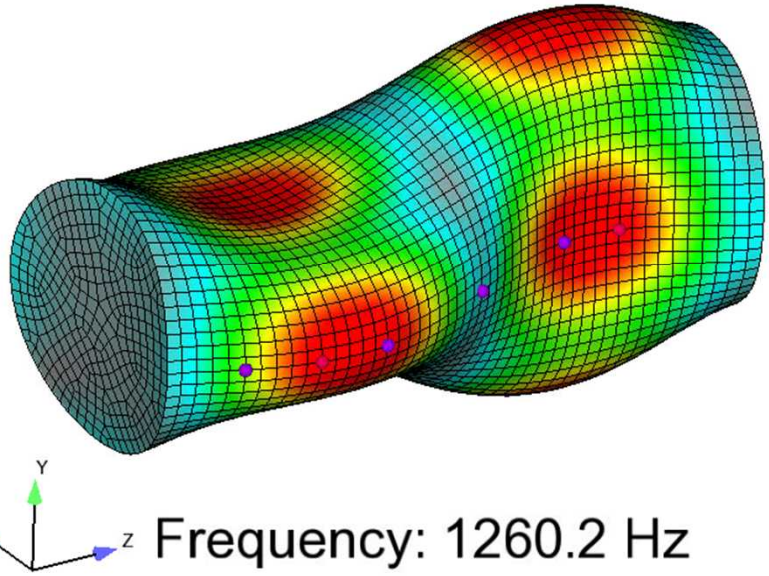


Frequency: 1080.8 Hz



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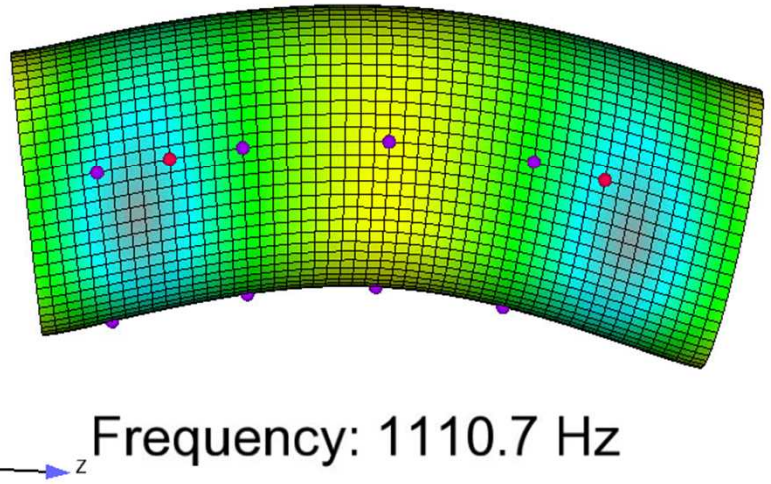
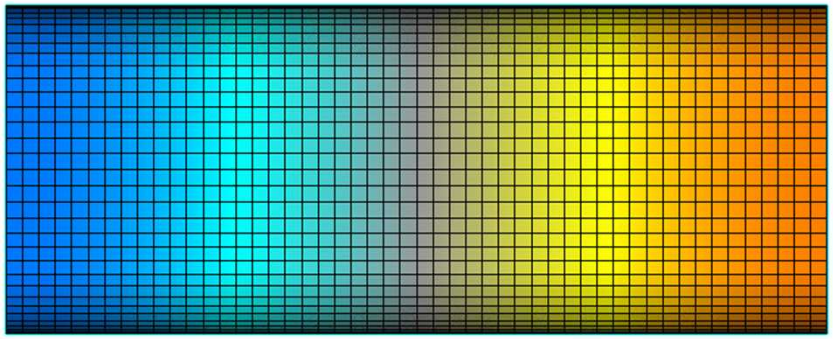
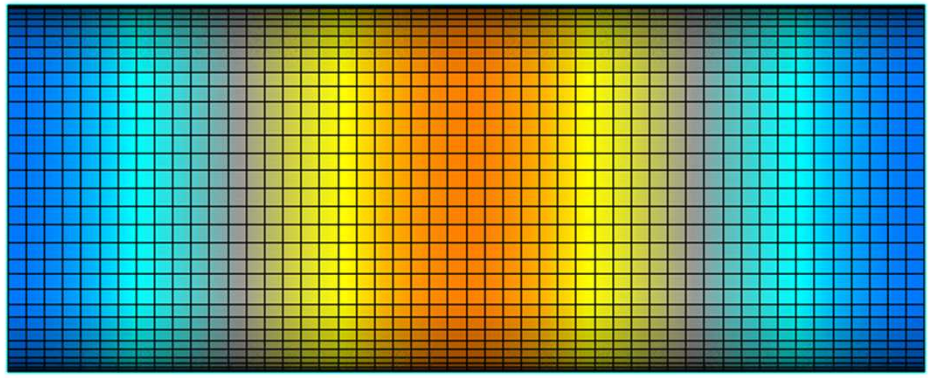
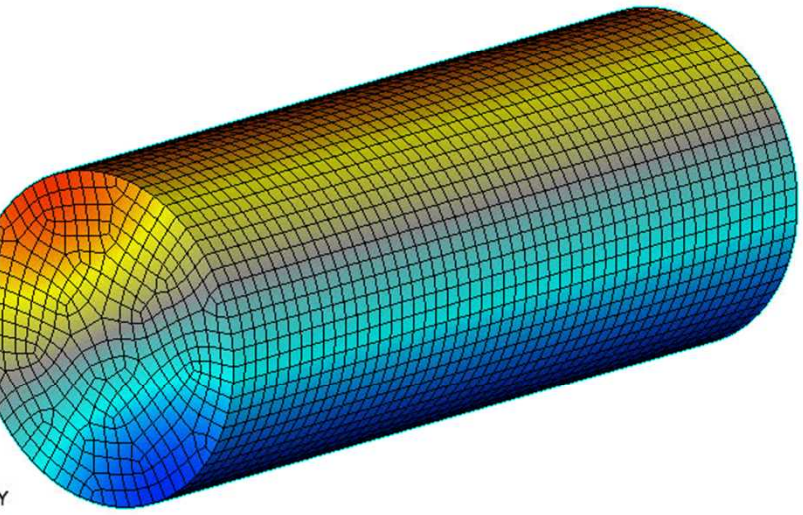


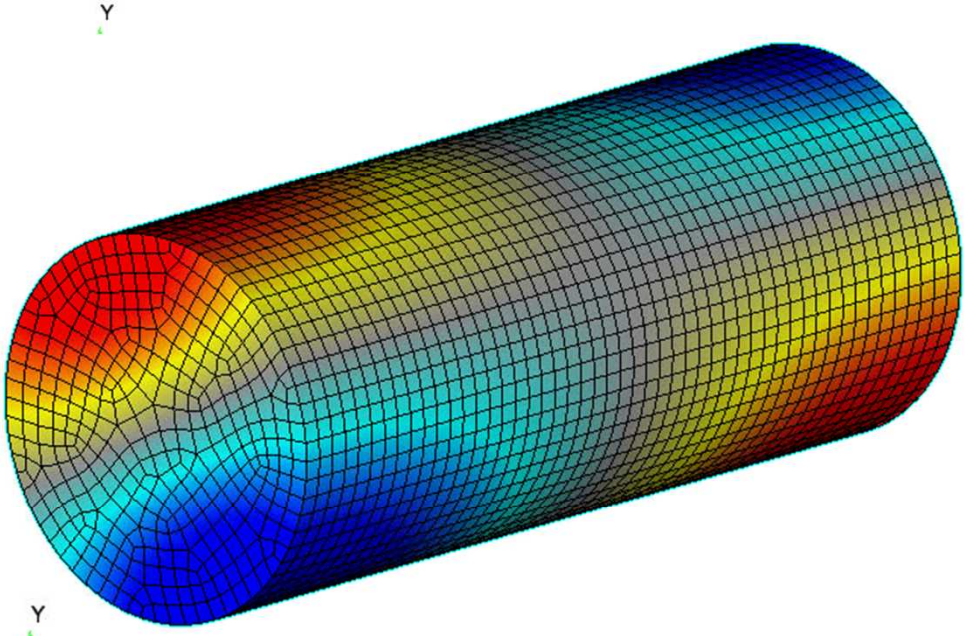
Frequency: 1110.7 Hz



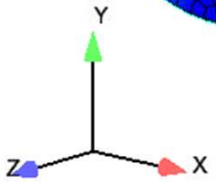


Frequency: 132.5 Hz

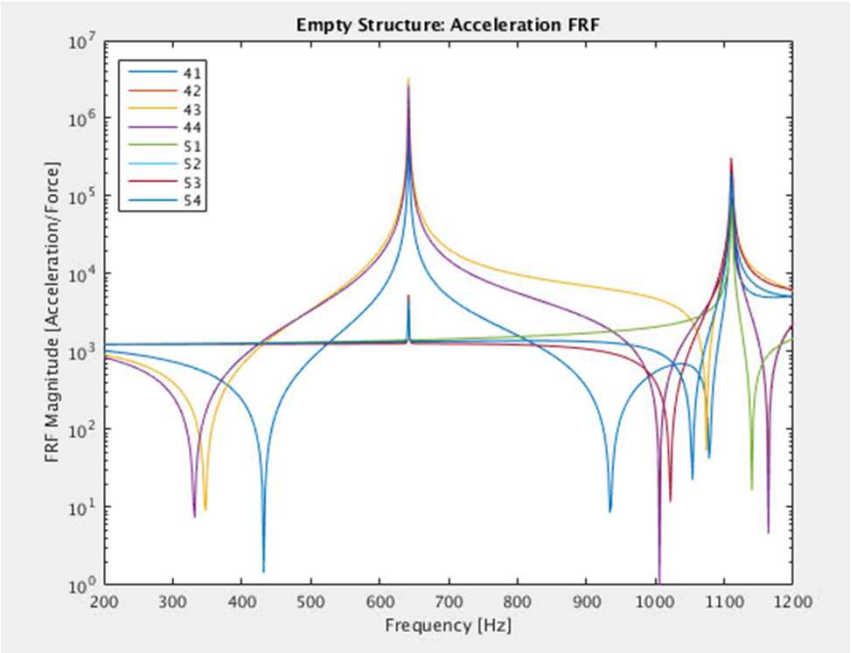




Frequency: 388.9 Hz



Frequency: 410.8 Hz


Empty Structure: Acceleration FRF
FRF Magnitude [Acceleration/Force]
Frequency [Hz]
41
42
43
44
51
52
53
54
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
200
300
400
500
600
700
800
900
1000
1100
1200