

Effect of Body Shape on the Vibration of Electric Guitars

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Co-authors



Modal Analysis

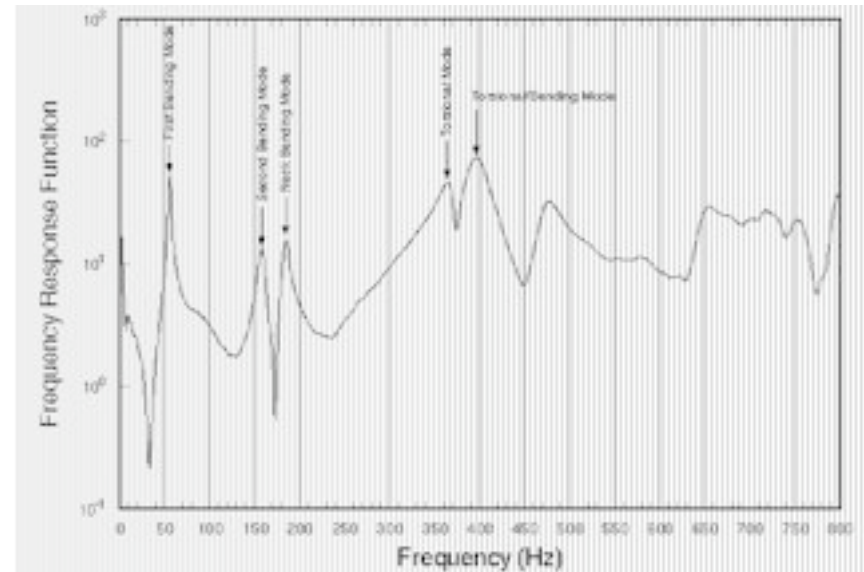
Fixed Response

Fixed Accelerometer
Roving Impact Hammer

Two-Channel FFT

Frequency Response Function
(accel/force)
0 – 800 Hz frequency range

Post Processing – STAR Modal
Polynomial & Quadrature Fits



The Guitars

Epiphone Coronet



Gibson Explorer



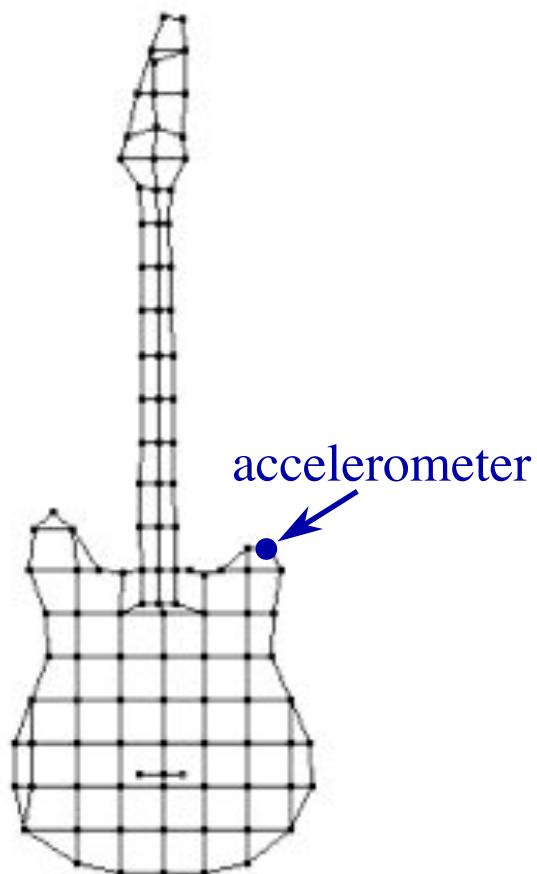
Gibson ES-335



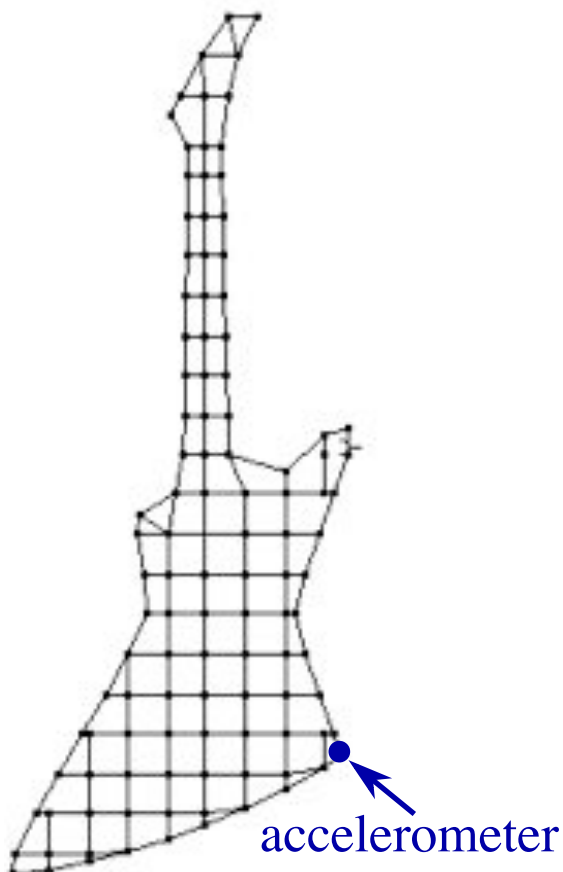
Acknowledgment: Coronet and ES-335 were donated to Kettering University Acoustics Laboratory by Gibson Guitars.

The Guitars — Measurement Setup

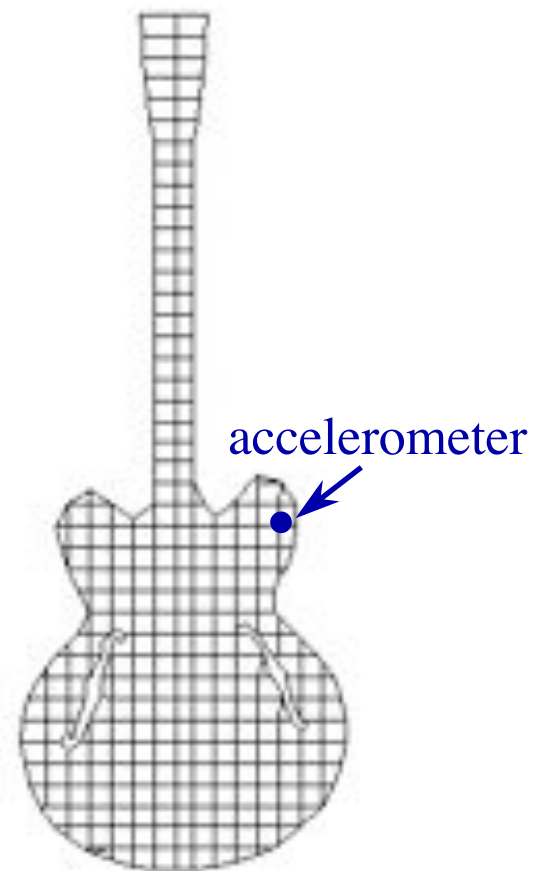
Epiphone Coronet



Gibson Explorer



Gibson ES-335

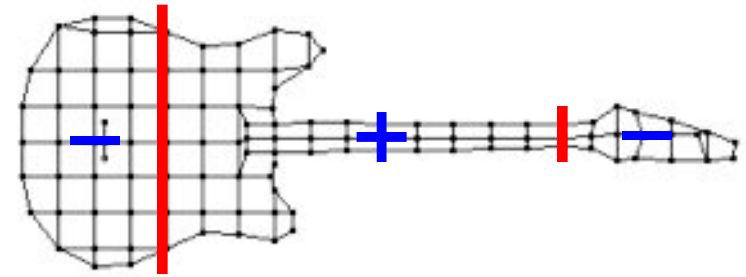
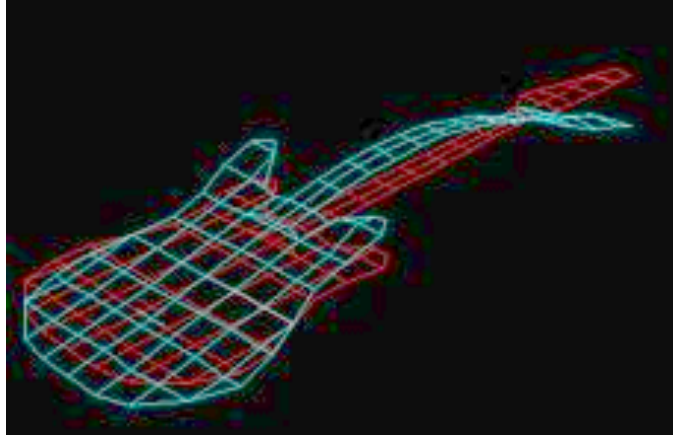


Strings were tuned to playing frequencies but were damped during testing

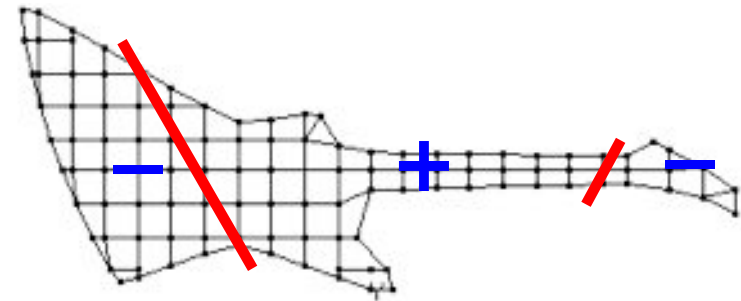
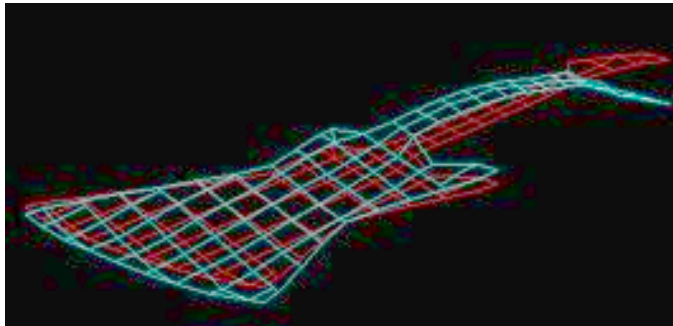


Mode Shapes — First Bending Mode

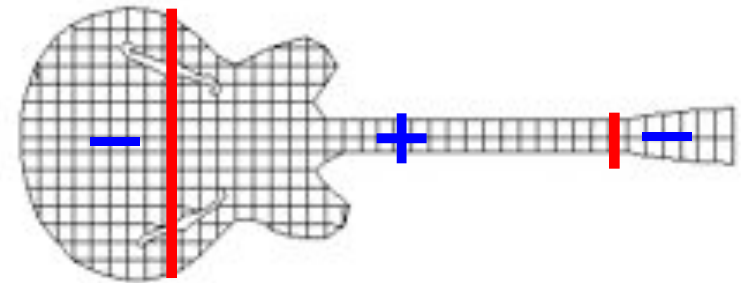
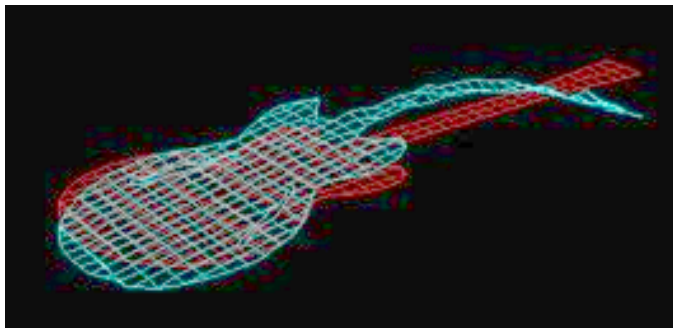
Coronet
55 Hz



Explorer
46 Hz

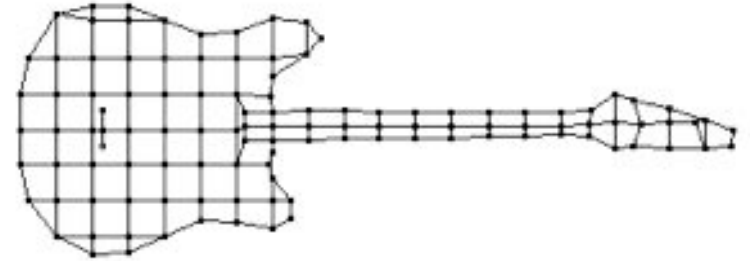


ES-335
46 Hz

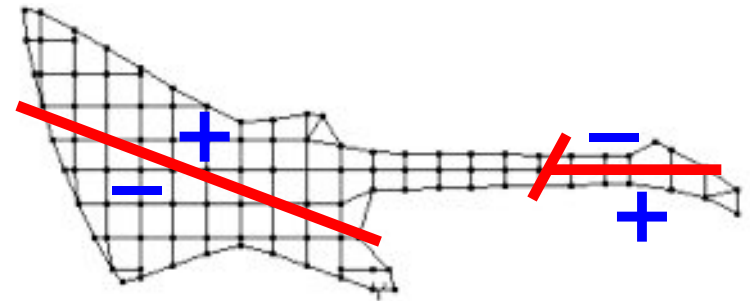
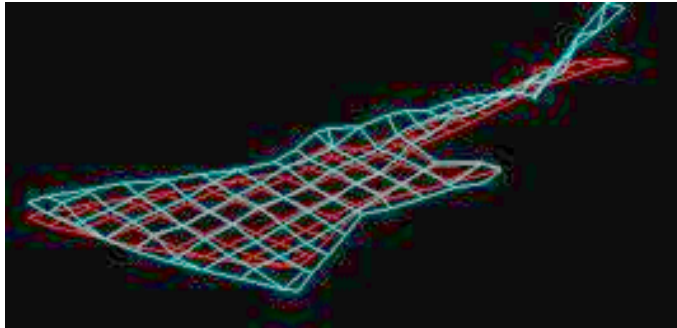


Mode Shapes — Twisting/Torsional Mode

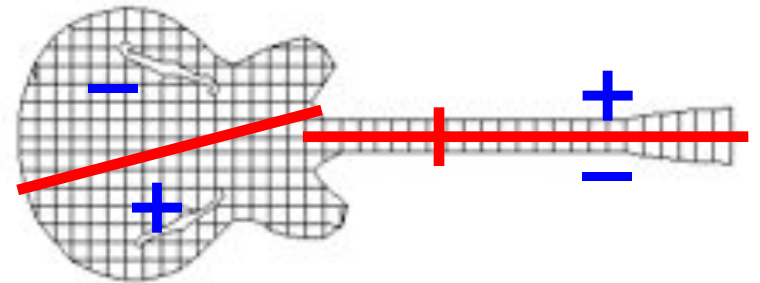
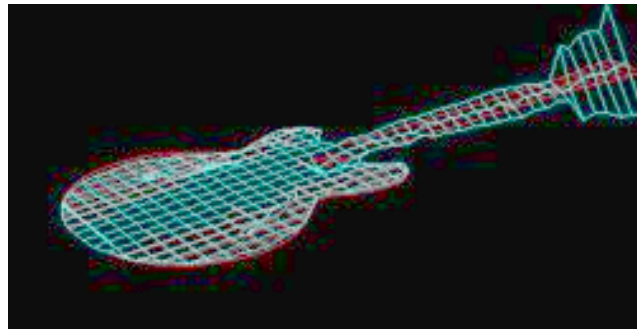
Coronet



Explorer
75 Hz

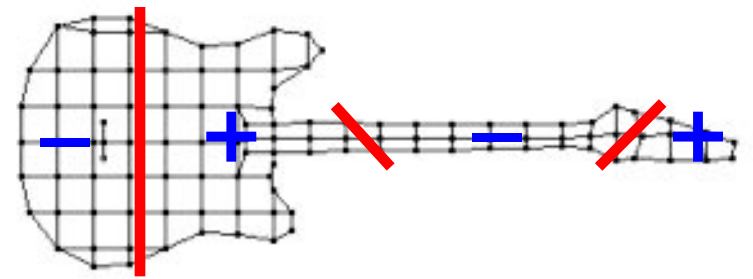
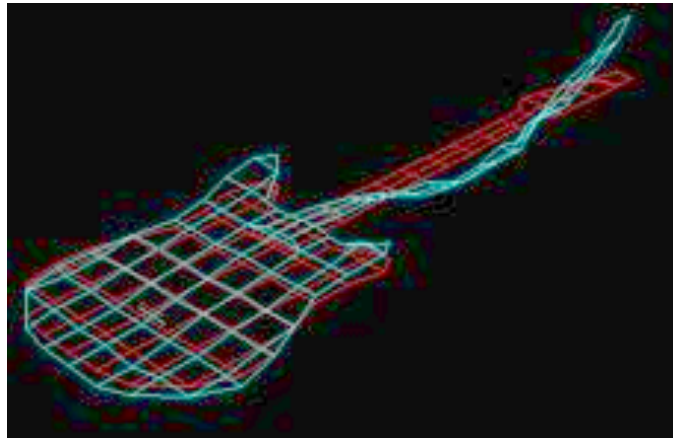


ES-335
46 Hz

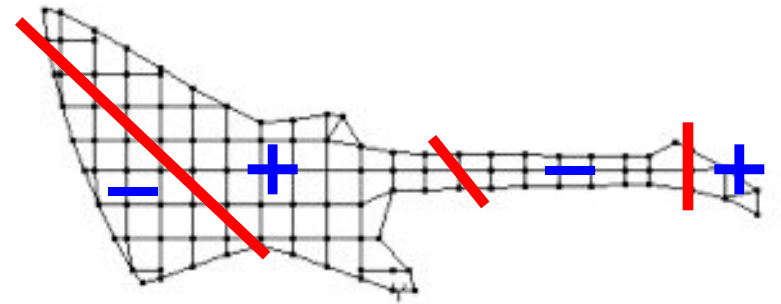
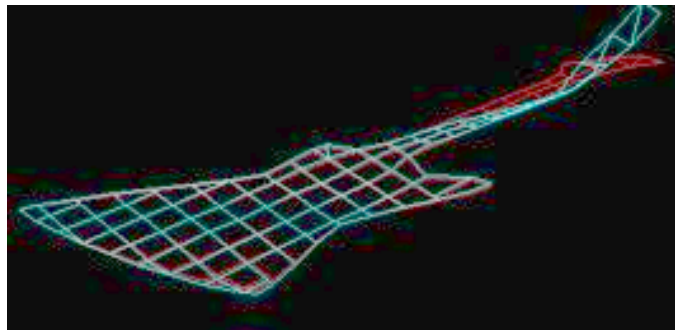


Mode Shapes — Second Bending Mode

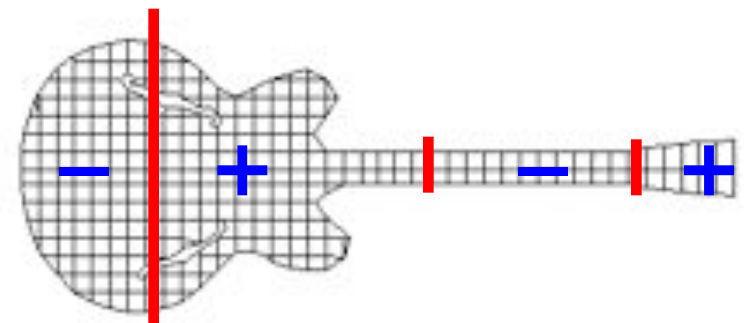
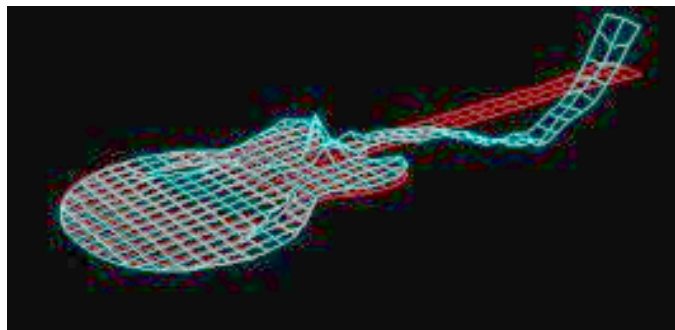
Coronet
160 Hz



Explorer
133 Hz

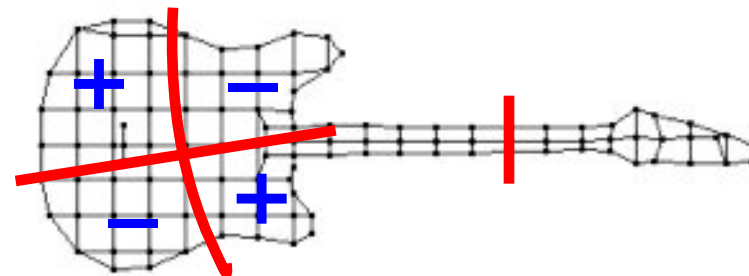
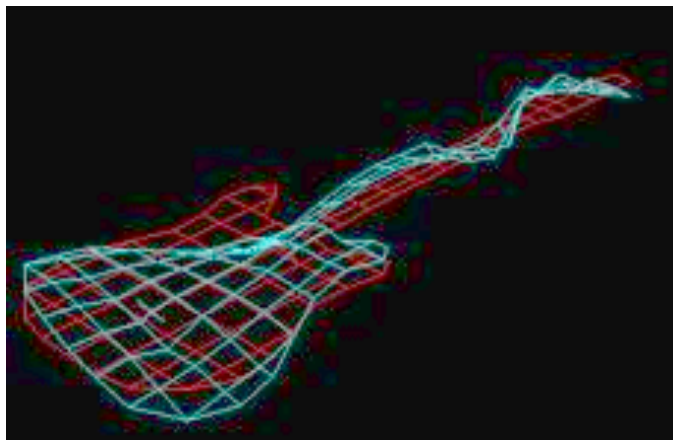


ES-335
150–180 Hz

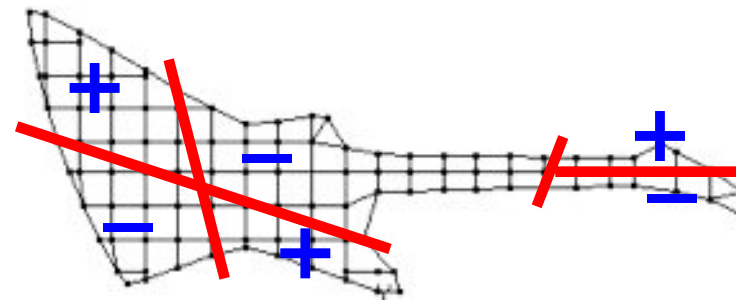
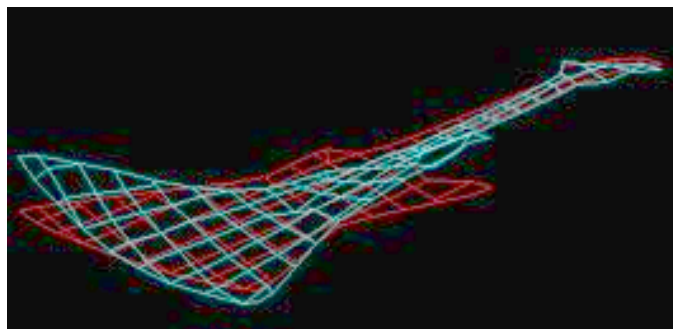


Mode Shapes — Torsional Mode

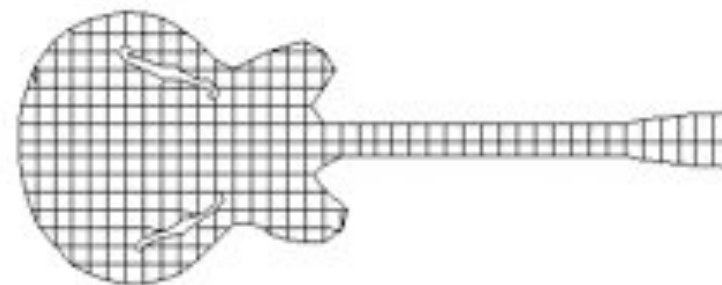
Coronet
372 Hz



Explorer
221 Hz

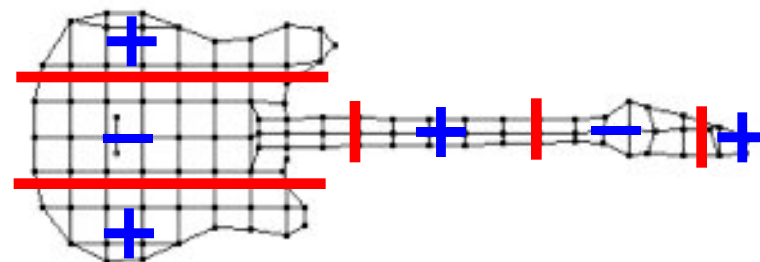
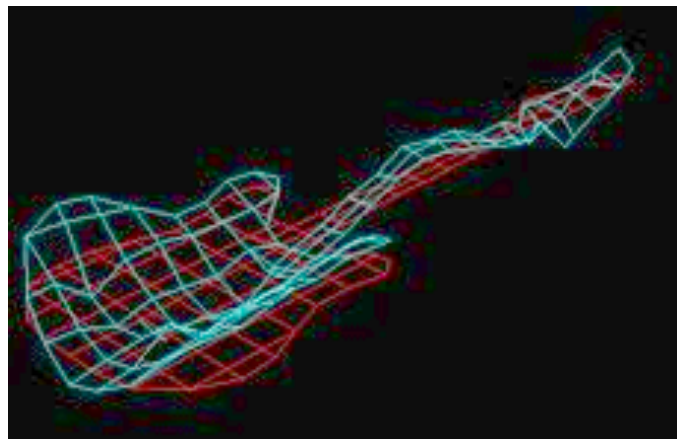


ES-335

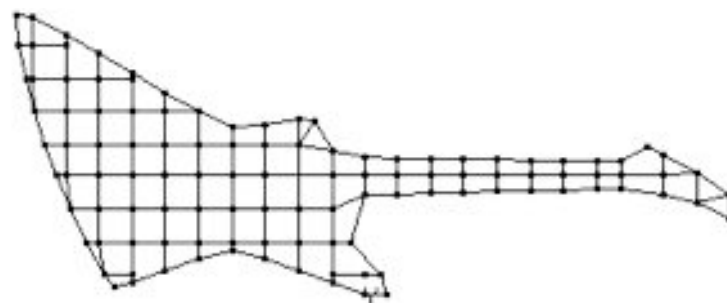


Mode Shapes — Bending — Width Mode

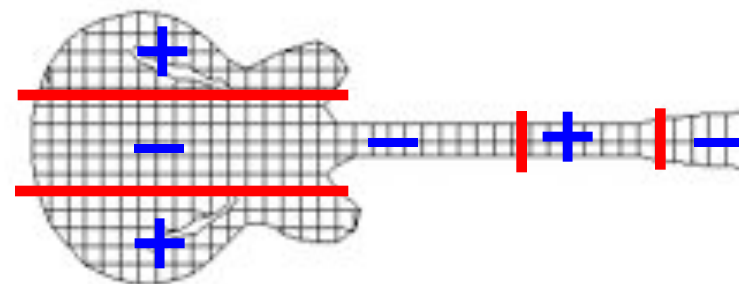
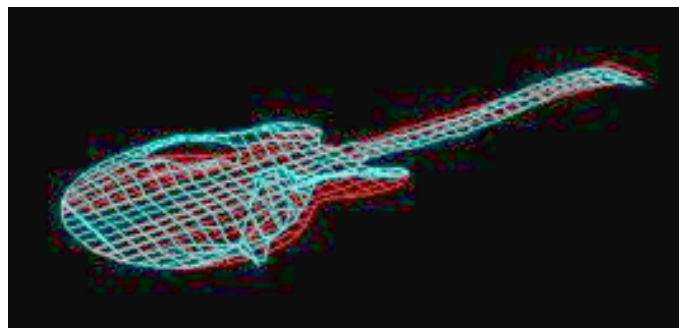
Coronet
472 Hz



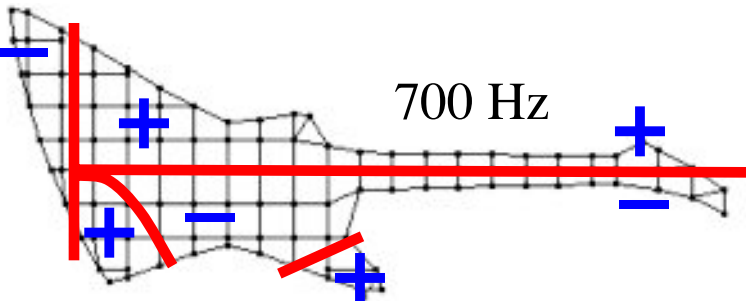
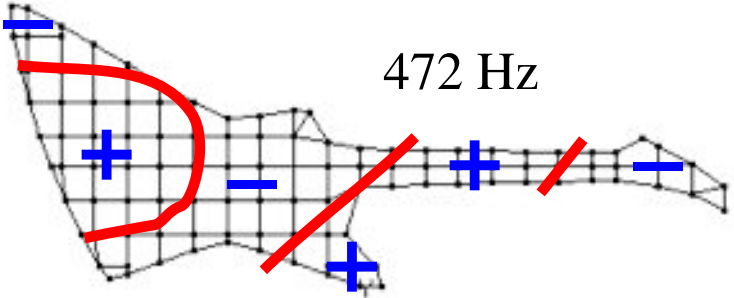
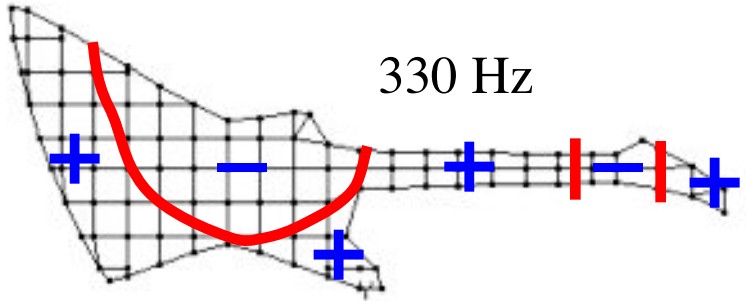
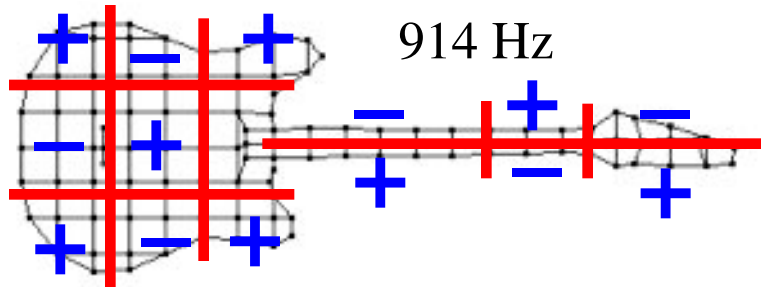
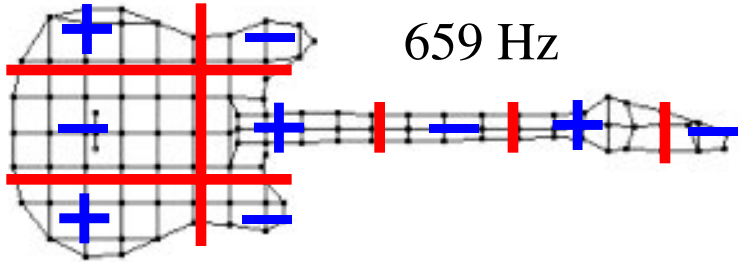
Explorer



ES-335
310 Hz



Other Mode Shapes



Future Work:

Finish bottom of ES-335

Correlate neck motion to "dead spots"

Correlate body resonances to poor sustain

Other guitar body shapes

Pickup Resonances



Animated mode shapes available at:

<http://www.kettering.edu/~drussell/guitars/>

