

The Acoustic and Vibrational Effects of Carbon Fiber Reinforced Plastic as a Sole Manufacturing Material for Acoustic Guitars

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Introduction

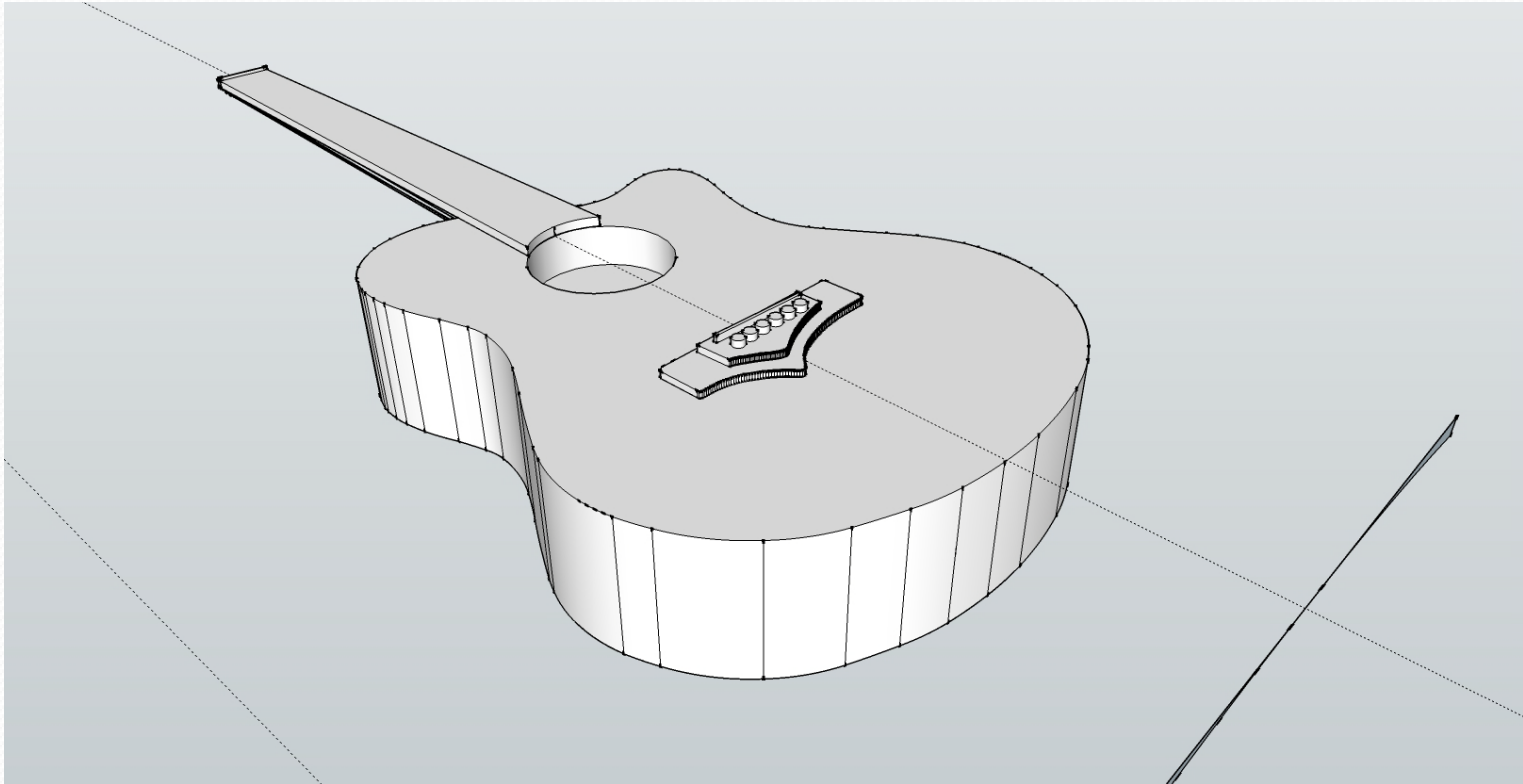
- Aim:
 - Phase 2 of a continuing project
 - Confirm validity and reliability of project from previous work
 - Study top plate eigenfrequencies

Model Design

- Soundboard constructed as a solid in AutoCAD
- Guitar measured with large 'outside' callipers
- Complex curves measured with a profile gauge
- CAD model imported into Rhinoceros and exported as an .igs file

Model Design (cont.)

- CAD image of guitar



Model Design (cont.)

- COMSOL
 - Structural Mechanics Module
 - Selected Physics; Solid Mechanics (Solid)
 - Preset Studies; Eigenfrequency

Model Design (cont.)

- Boundary Settings:
 - Free Constraint
 - Top, bottom of the of the sound board and interior boundary of the sound hole
 - Fixed Constraint
 - All outside edges of the soundboard

Model Design (cont.)

- Material Contents

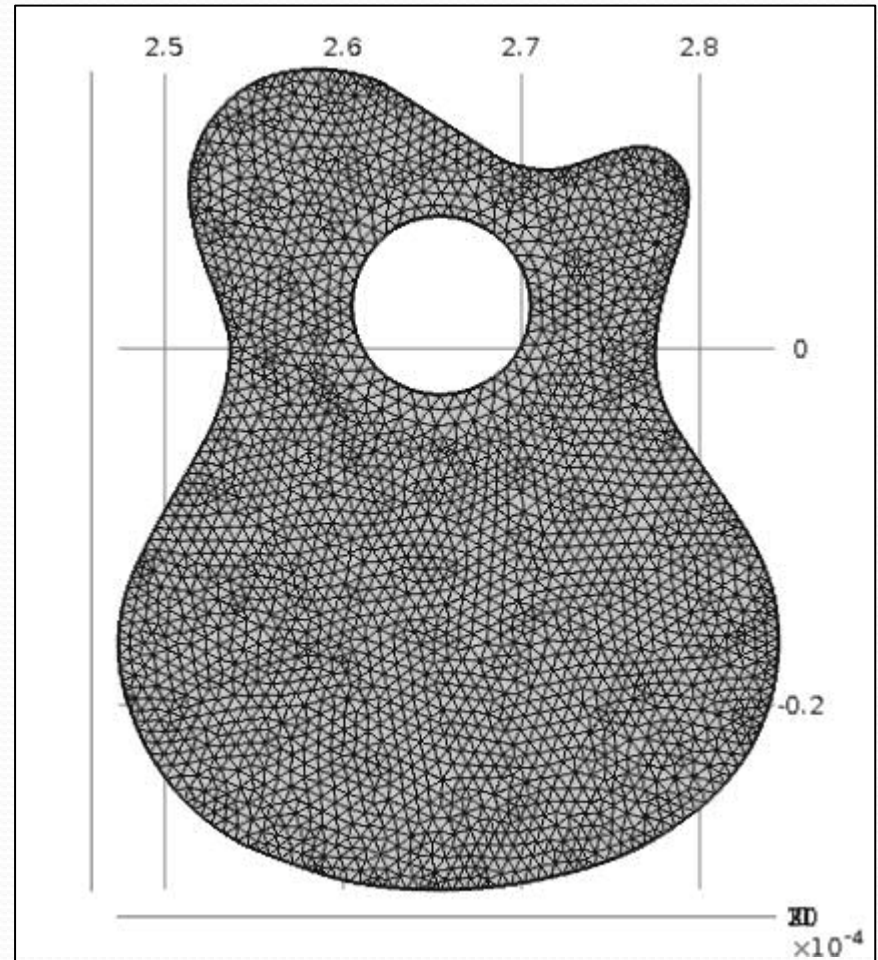
Variable	Value	Units
Young's Modulus	1.01e9	Pa
Density	1015	Kg/m ³
Poisson's Ratio	0.28	

- Linear Elastic Material Model

Variable	Value
Anisotropic Loss Factor	0.02

Model Design (cont.)

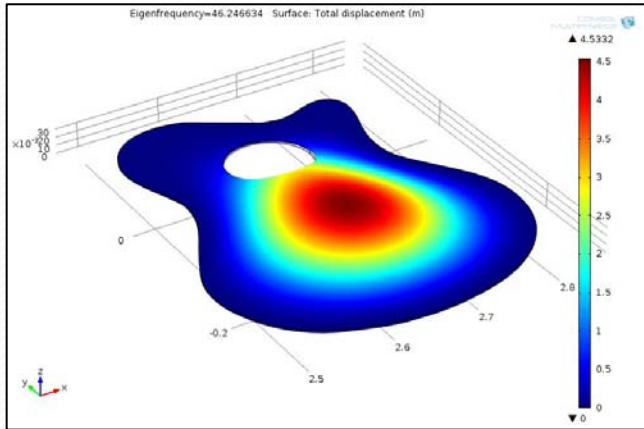
- Mesh Detail;
 - Free tetrahedral mesh
 - 14264 elements
 - 87900 degrees of freedom
 - Normal element size



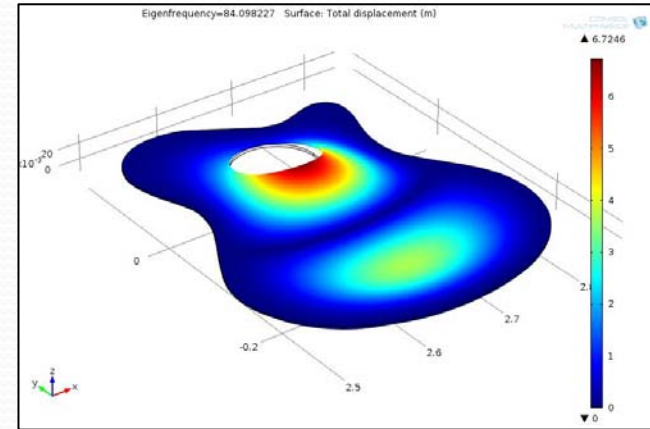
Results

Table 1 – Comparison of soundboard versus plate

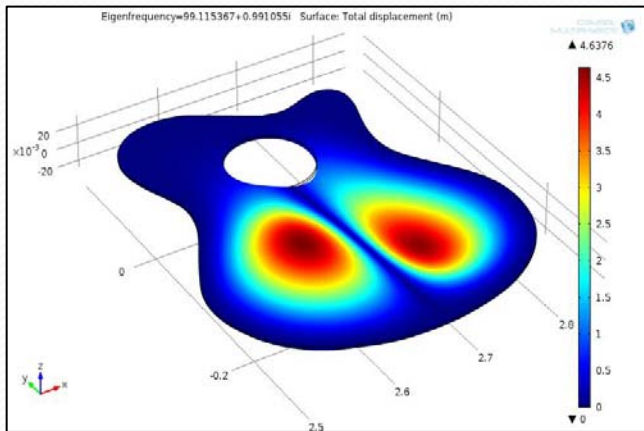
Eigenfrequency No.	Soundboard	Plate
1	46	35
2	84	62
3	100	79
4	139	105
5	151	107
6	168	147
7	175	148
8	205	168
9	240	172
10	251	207



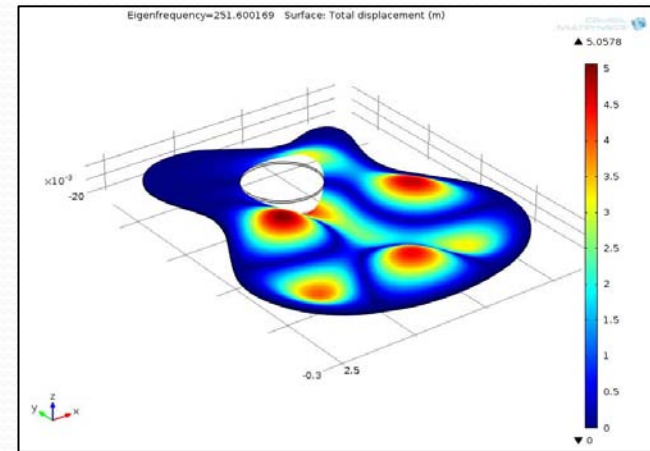
First Eigen-frequency



Second Eigen-frequency



Third Eigen-frequency



Tenth Eigen-frequency

Phase 3 + Further Work

- Full guitar model
- Sound-field measurements
- Holographic Interferometry
- Fluid dynamics – air/body interaction



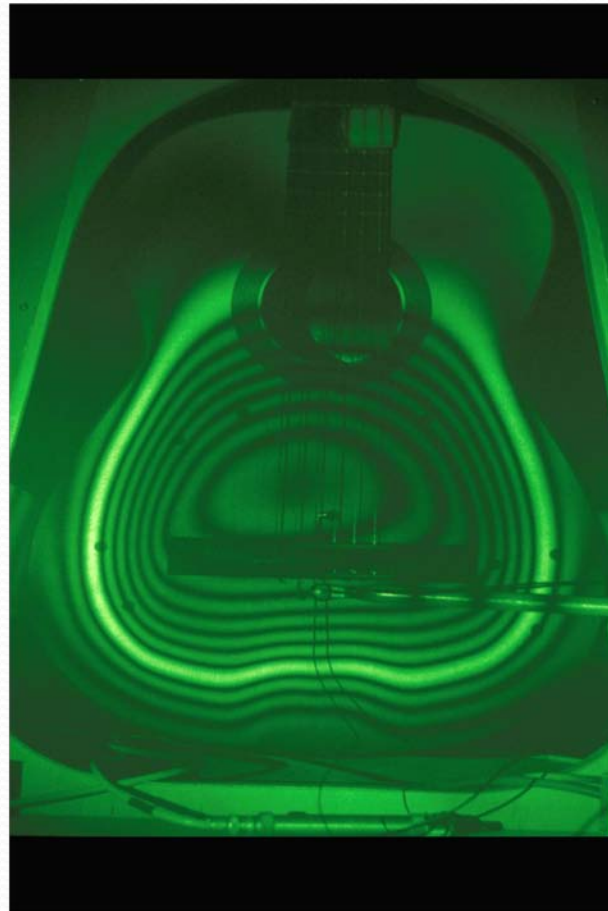
X10



T20



X7



Picture taken from:

Proceedings of the Second Vienna Talk, Sept. 19 –21, 2010, University of Music and Performing Arts Vienna, Austria **“Mode Studies of Plucked Stringed Instruments: Application of Holographic**

Interferometry” pp 129 - 132

Richardson, B. Cardiff University

Conclusions

- This study has given positive results which will be confirmed through collaboration later this year.
- High level of confidence for further work in this area

Questions?

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Thanks for Listening
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