

# A Study of the Acoustic Response of Carbon Fiber Reinforced Plastic Plates

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# Introduction

- Aim:
- Introduction to continuing project
- Ascertain validity and reliability of project for further work
- Simple model to attain physical characteristics of CFRP used by manufacturer

# Experimental Data Collection



- The CFRP plate was clamped in position (FIG 1) was struck several times and the output recorded into Logic 9 using an earthworks M30 HD measurement microphone.
- Audio files were then consolidated and imported into Fuzzmeasure pro 3 and the frequency response was then analysed and compared.

**Figure 1** – Microphone position over clamped CFRP

# Results

Frequency Response (1/12 Octave Smoothing)

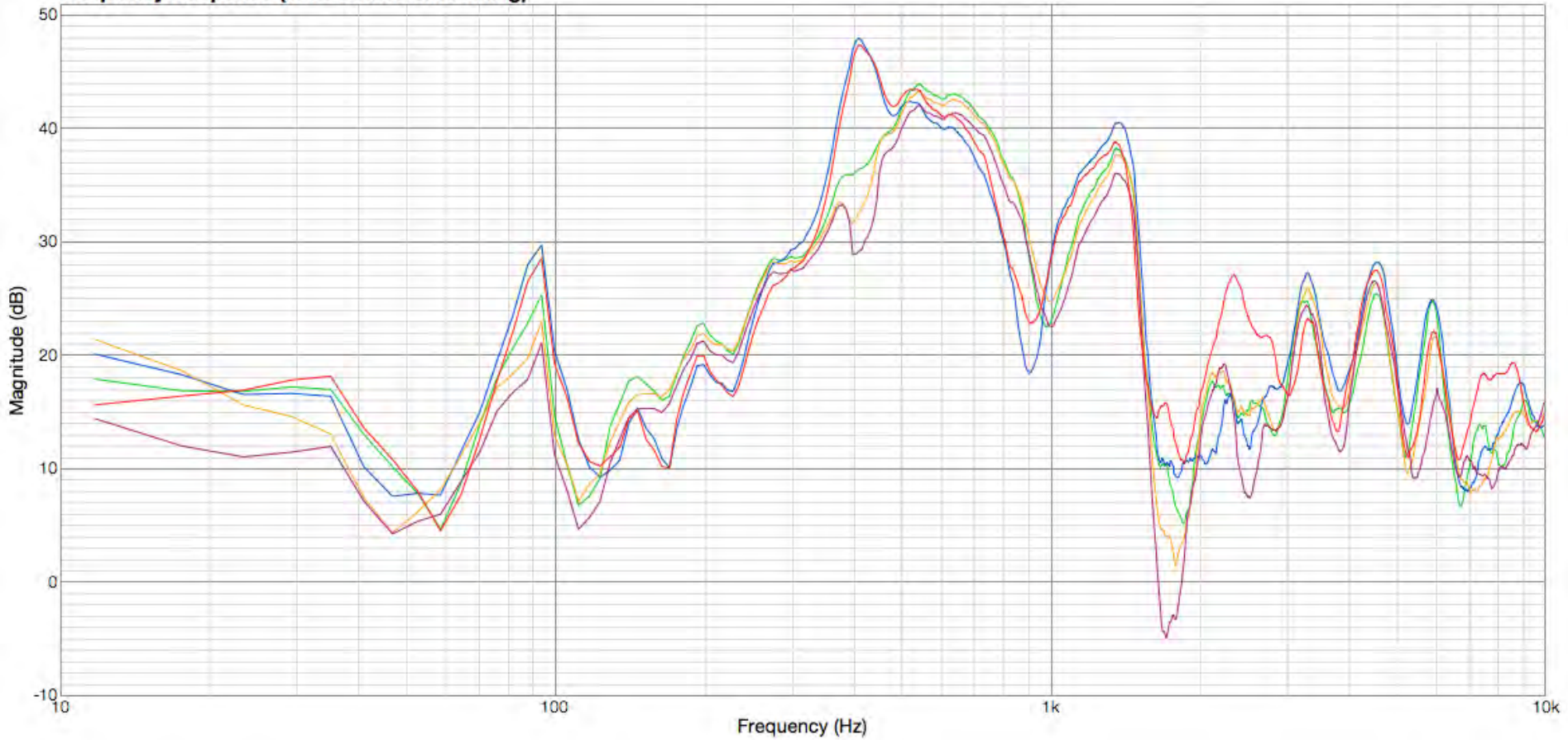


Figure 2 - Experimental Data - Frequency Response of CFRP

# Model Design

- Space Dimension – 3D
- Structural Mechanics Module > solid, stress, strain (smsld)
- Dimensions:
  - L: 0.269[m]
  - W: 0.23[m]
  - D: 0.0033[m]

# Model Design (cont.)

- Boundary Settings:
  - 1,2,5,6 – Fixed
  - 3,4 – Free
- Sub-domain Settings:
  - Young's Modulus:  $1.01 \text{ e}9 \text{ [Pa]}$
  - Density:  $1015 \text{ [kg/m}^3\text{]}$
  - Poisson's Ratio:  $0.28$
  - Damping: Loss Factor –  $0.2$
- Point Settings
  - Point 5 (centre of plate  $(0,0)$ ) – Load:  $-5 \text{ [N]}$

# Model Design (cont.)

- Integration Coupling Variables
  - Boundary Variables
    - Boundary 3 (top of plate)
      - Name – ‘mydisp’
        - Expression:  
$$\sqrt{(\text{real}(\text{disp\_smsld}) * \text{real}(\text{disp\_smsld})) + (\text{image}(\text{disp\_smsld}) * \text{image}(\text{disp\_smsld}))}$$

# Model Design (cont.)

- Solver parameters:
- Analysis Type:
  - Frequency response > parametric
  - Parameter Values:
    - Model 1: 0:10:2500
    - Model 2: 2500:10:5000
    - Model 3: 5000:10:7500
    - Model 4: 7500:10:10000



# Results

**Table 1** – Comparison of experimental data and experimental data collected

Frequency [Hz] (experimental data)	Frequency [Hz] (simulated data)
<b>93</b>	<b>93</b>
<b>181</b>	<b>172</b>
<b>199</b>	<b>208</b>
<b>275</b>	<b>280</b>
<b>380</b>	<b>384</b>
<b>410</b>	<b>401</b>
<b>451</b>	<b>453</b>
<b>544</b>	<b>568</b>
<b>638</b>	<b>619</b>
<b>1353</b>	<b>1335</b>
<b>1705</b>	<b>1700</b>

# Results (cont.)

Frequency [Hz] (experimental data)	Frequency [Hz] (simulated data)
1851	1852
2220	2211
2736	2738
4564	4544
5900	5934
7441	7435
7505	7518
8085	8022
8636	8631
8853	8841
8929	8931
9076	9071

# Phase Two + Further Work

- Obtain and model CFRP guitar from:
- [Emerald Guitars](#)
- Can the guitars frequency response or timbre be altered to suit an individuals specific tastes giving them the guitar of their dreams



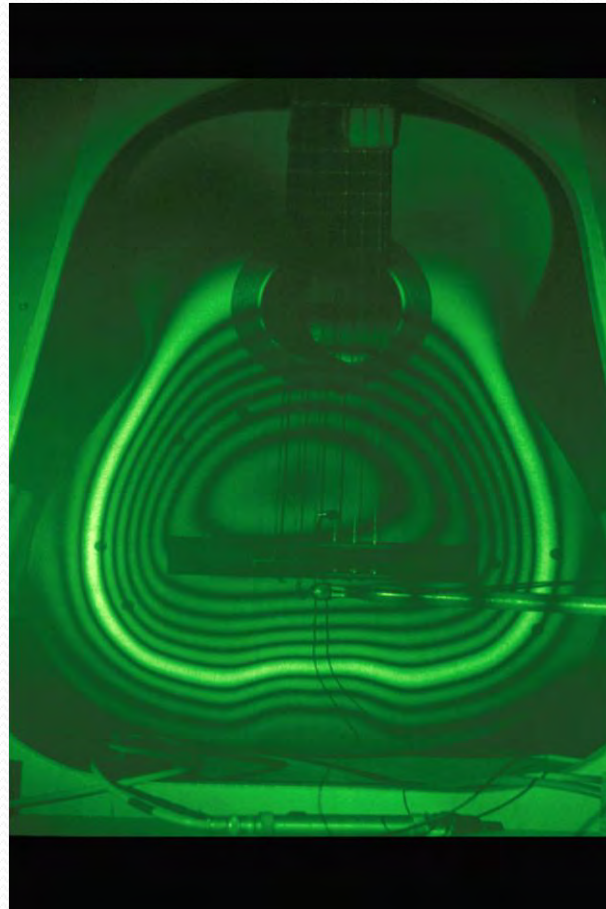
X10



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 initial study has shown to be a successful beginning, providing excellent results
- High level of confidence for further work in this area

# Questions?

Thanks for Listening  
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