



Analysing and Modelling the Frequency Response of an Acoustic Guitar

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Aims

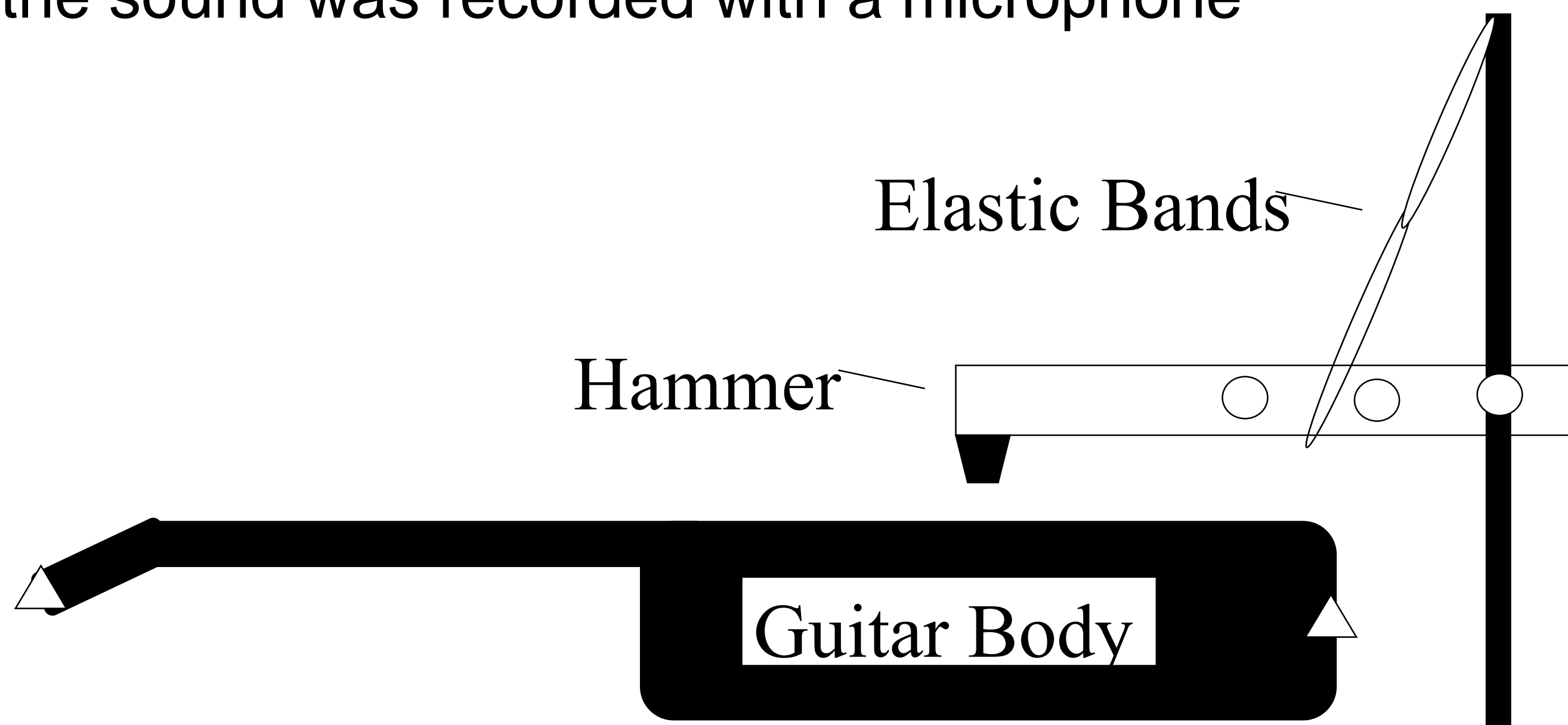
Acoustic guitars are among the most popular instruments of modern music. However the design of the instrument remains relatively stagnant. Guitar builders, luthiers, tend to rely on traditionalism and experience to obtain the "tone" (i.e. the sound quality) they want.

This project aims to research a more quantitative methodology for guitar building. The goal is to measure and analyse the frequency response of an acoustic guitar, and ultimately build a model to allow for a systematic altering of the sound produced by it.

Method

Exciting guitar body into vibration

The guitar was struck with a hammer and the sound was recorded with a microphone



Changing parameters and measuring frequency response

- The response was recorded for different parameter changes made to the guitar.
- Changes to the top mass, side mass and the sound hole were made
- Chladni Plate experiment



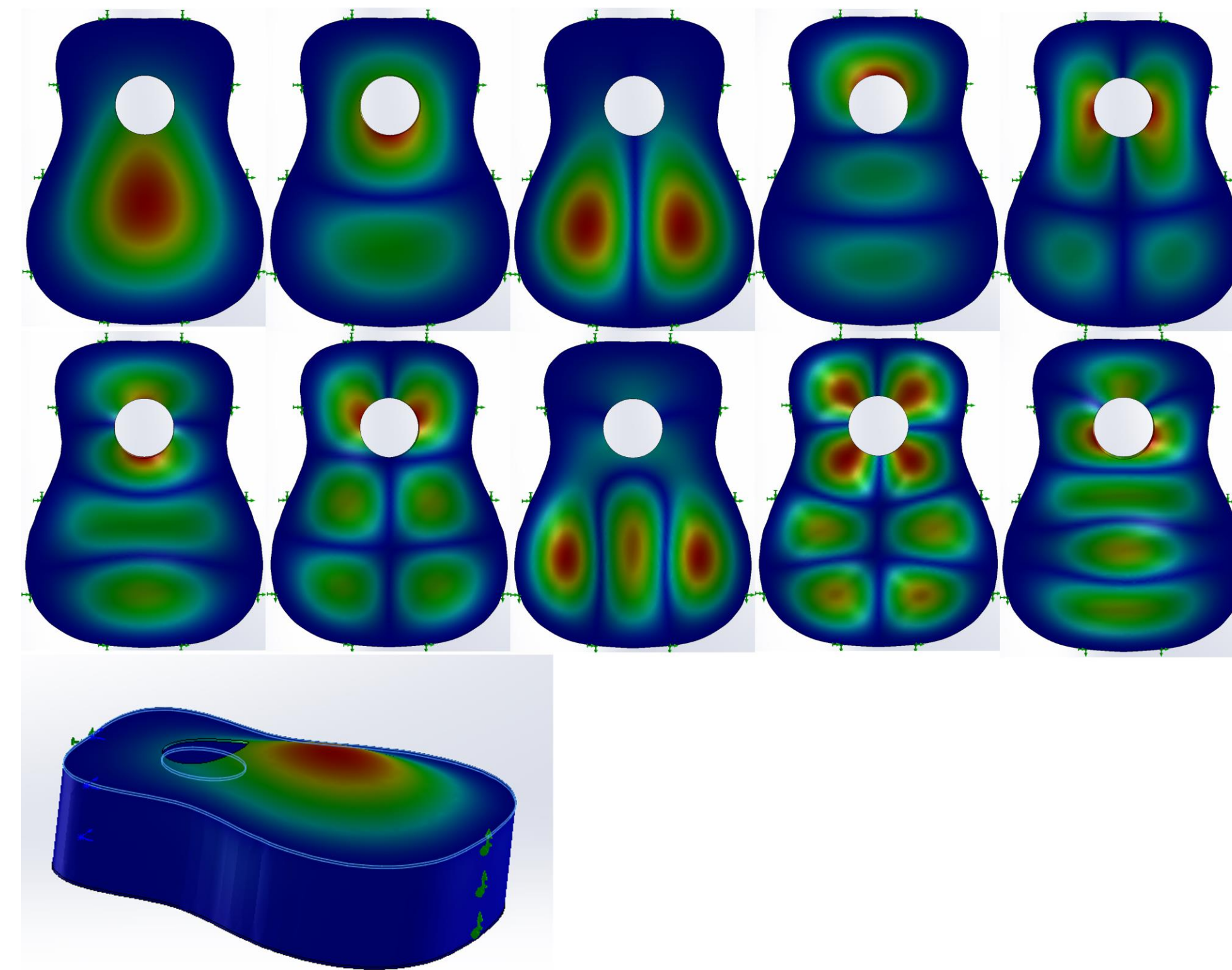
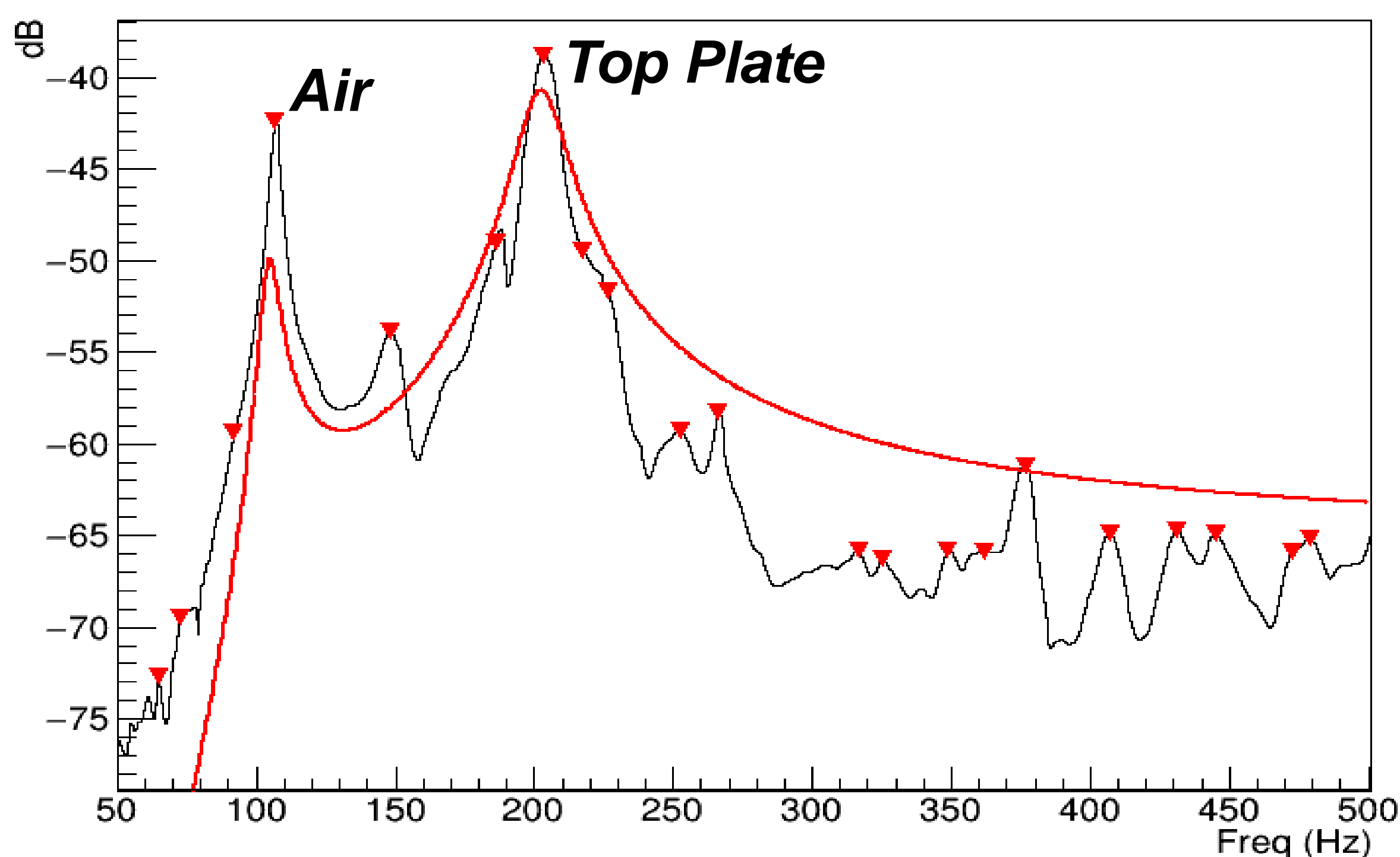
Analysis and Modelling

2 DOF Coupled Oscillator Model

The frequency spectrum was plotted and compared to a 2DOF Model, a coupled oscillation between the top plate and the Helmholtz frequency (Air).

Finite Element Analysis

Using Solidworks, a CAD model was created, this helped to identifying modal patterns and match them to the corresponding peaks in spectrum.



Results

Peak positions for various sound hole sizes

Parameters normalised for comparison with model. Data follows similar trend, but the model fails for small sound hole sizes

Peak positions for various top plate masses

Again, data follows a similar trend. Not a perfect fit due to model limitations.

