Acoustical Analysis of a Home Recording Studio

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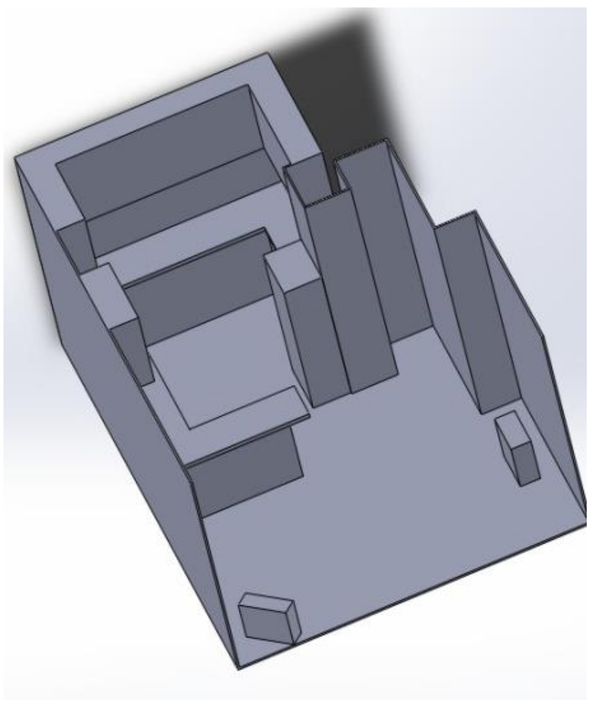
Introduction: This poster presents the results of an acoustic analysis of a home recording studio. For the home recording studio owner, the most relevant question is "Where should the speakers be put for best sound?" To illustrate these effects we use COMSOL Acoustics to compute the eigenmodes of a home recording studio.



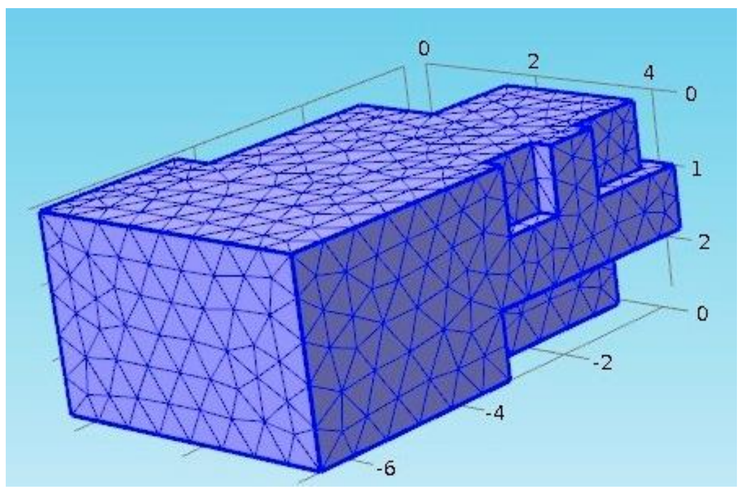


Figure 1. Geometry and mesh of recording studio

Computational Methods: The Helmholtz Eqn. was solved for the eigenfrequencies or the room air where p = pressure, ρ = density, k = wavenumber, f = frequency, and c = speed of sound.

$$\nabla \cdot \left(\frac{1}{\rho} \nabla p \right) = -\frac{4\pi^2 f^2}{c^2 \rho} p$$

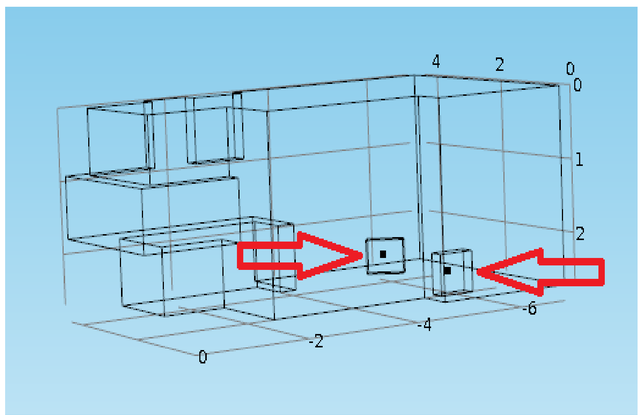


Figure 2. Flow point boundary conditions used to simulate speaker location in recording studio

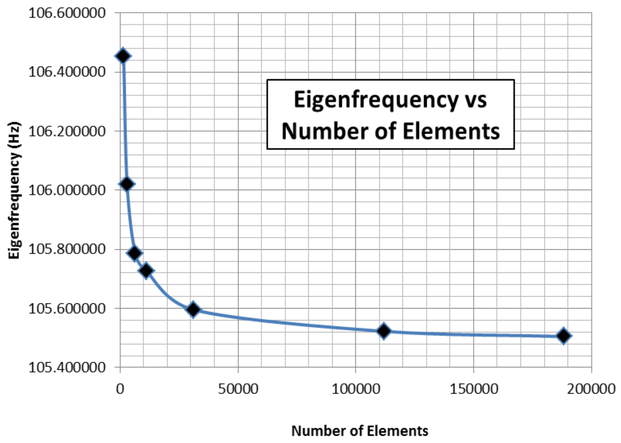


Figure 3. Typical mesh size convergence study results

Results: The eigenmode shows the sound intensity pattern for its associated eigenfrequency. From the characteristics of the eigenmodes we can draw some conclusions as to where the speakers should be placed

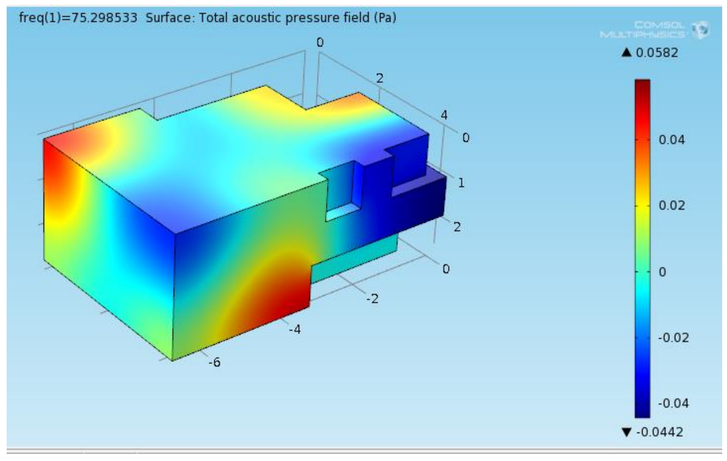


Figure 4. Acoustic pressure for speakers forced at 75 Hz

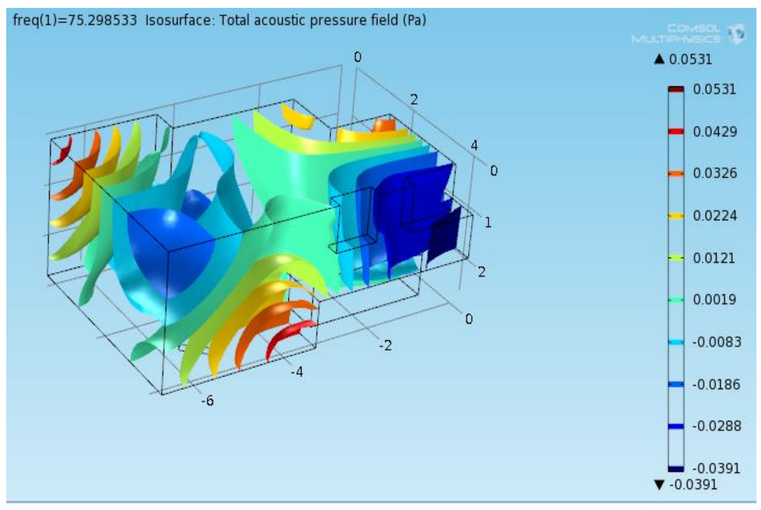


Figure 5. Isobaric surfaces for speakers forced at 75 Hz

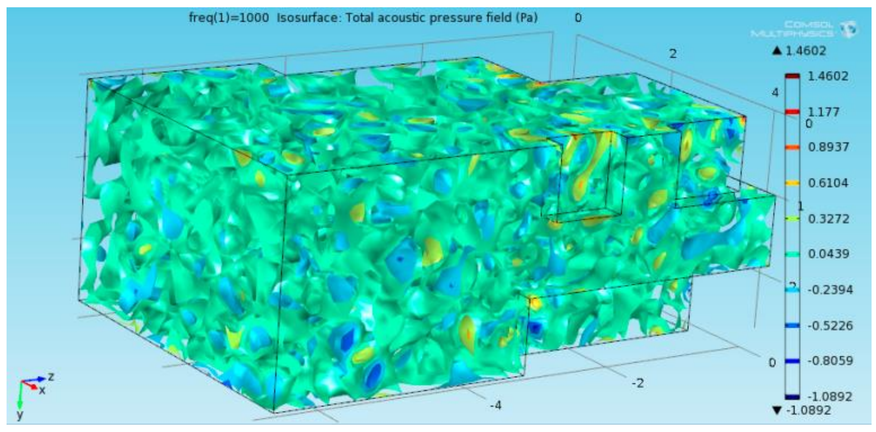


Figure 6. Isobaric surfaces for speakers forced at 1000 Hz

Conclusions: Lower frequencies (50~150 Hz) are of interest since they are where the fundamental resonance exists for a given dimension of the room [1].

References:

1. M. Moser, Engineering Acoustics, 2nd. Ed. Springer, New York, NY, 2009.