Acoustical Analysis of a Home Recording Studio

K. Anderson[1], A. Smith[1], D. Forgette[1]

[1]Mechanical Engineering, California State Polytechnic University at Pomona, Nonlinear FEM/CFD Multiphysics Simulation Lab, Pomona, CA, USA

Abstract

In this poster the acoustic analysis of a small home recording studio is presented. The poster will present background information, modeling technique, mesh independence studies, and comparison to theory. Figure 1 illustrates the recording studio room which was simulated using the COMSOL Multiphysics® Acoustics Module [1]. The propagation of sound is modeled as pressure waves in which modal analysis is performed in the frequency domain [2]. Rooms naturally have nodes and anti-nodes lending themselves favorably to an acoustical analysis. Things to avoid when performing acoustic analysis include resonances and nodes being set up in the room geometry. The use of COMSOL quickly allows engineers to assess the performance of a given room configuration. Lower eigen-frequencies are the most critical to understand when dealing with room acoustics. Figure 2 illustrates typical results of the model correlation/mesh independence study of our investigation. Figure 3 shows the results of acoustic analysis assuming sound hard wall boundary conditions in a meduim of air having a density of 1.24 kg/m^3 and a corresponding speed of sound of 343 m/s. Once the baseline recording studio COMSOL acoustic simulation model was deemed to be properly functioning per the modal analysis simulations and grid independence studies described previously, it was exercised in order to ascertain the effects of speaker placement in the recording studio. The speakers were driven in the room via a point load boundary condition. Typical results for this "speaker projection analysis" are given in Figure 4. Information The results obtained herein agree qualitatively with what is expected to actually occur, i.e. there are noticeable regions of high pressure in the corners of the room.

Reference

[1] COMSOL Handbook
[2] Engineering Acoustics, Michael Moser, 2nd Ed., Springer, New York, 2009.

Figures used in the abstract

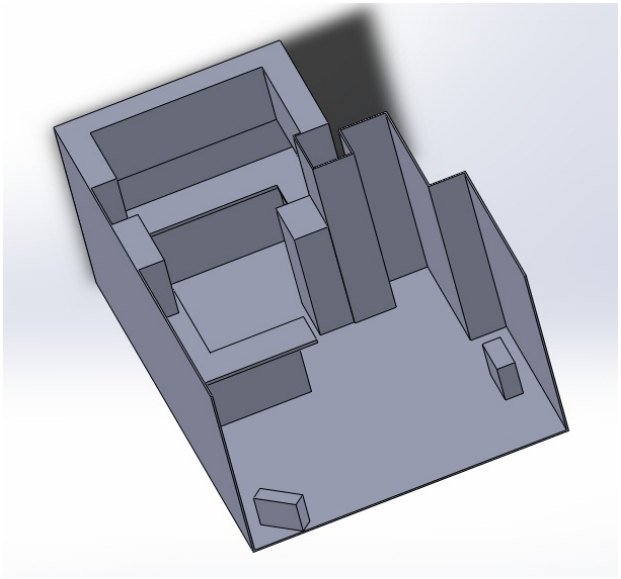

Figure 1: Recording Studio Room Geometry.

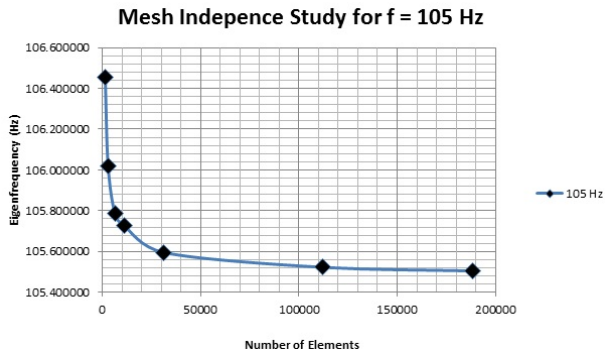

Figure 2: Mesh Independence Study for f = 105 Hz Eigen-frequency.

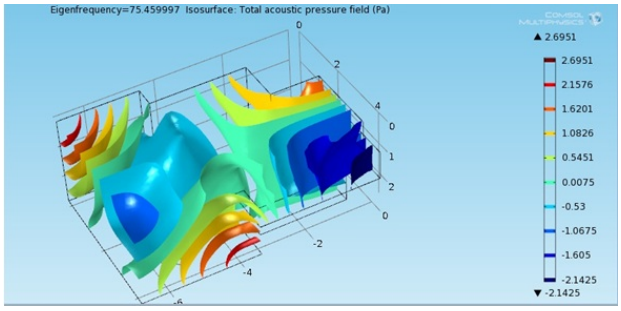

Figure 3: Pressure Field Iso-Bars for Eiqen-frequency of 75.45 Hz.

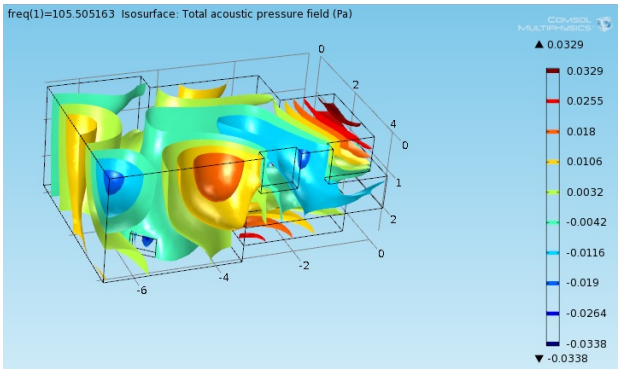

Figure 4: Pressure Field iso-bars corresponding to f = 105 Hz Speaker Projection Simulation.