Transducer Optimization with Differential Equations

A01159865

19 April 2016

Abstract: The goal of this presentation will be to show how differences in the build of an enclosure surrounding a transducer change the sound that the transducer produces. Through this project I will derive a set of equations that demonstrate the changes in waveforms produced by the transducer due to changes in the enclosure surrounding it. The acoustical equation will be particularly useful $\frac{\partial^2 u}{\partial t^2} = \frac{7}{5}\sigma_o^2 \nabla^2 u$. The model produced will likely be a set of partial differential equations that require numerical analysis to approximate. The importance of this model is that it will allow for the optimization of enclosures.

Outline

Different enclosures affect each type of speaker in a unique way. For the purpose of this presentation I will be considering a generic subwoofer, a large speaker that reproduces low frequencies in the range 20-150 hz. The enclosure type I am going to consider is a bass-reflex enclosure which has a vent to allow for rear wave reinforcement of the front wave. Analysis of how this rear wave affects the front wave can be done with use of differential equations. In my presentation I will demonstrate exactly what the "front" and "rear" waves are, as well as give a simple outline of how a bass reflex enclosure works. The size and dimensions of the enclosure will affect how front wave reinforcement occurs. It will be necessary to analyze how changes in the enclosure surrounding the transducer affect the output from the transducer. Due to the subjectivity of the quality of sound from a speaker, the sound pressure level (SPL) output of the speaker is all I will consider. A model for how changes in the enclosure affect the output of a speaker can be done with a partial differential equation model.

References

1. http://www.silcom.com/~aludwig/Physics/Main/Acoustic_equations.html
2. http://www.silcom.com/~aludwig/Physics/Main/Coupling_power.html
3. http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1031&context=aerosp
4. https://en.wikipedia.org/wiki/Acoustic_wave_equation
5. https://en.wikipedia.org/wiki/Acoustic_theory