Distributed Mode Loudspeaker Investigation

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Abstract:

The project is about building a loudspeaker for home use by implementing DML technology which makes the process simpler and cheaper. Technology will be investigated in order to find the best design solution within low budget and limited access to materials. Prototypes will be tested for performance and some creative solutions will be applied for improvement.

Introduction

DML - Distributed Mode Loudspeaker is a technology based on the way bending waves propagate through a medium. Device called audio exciter is attached to a thin, rigid panel. When fed with audio signal, it causes the plate to resonate creating many modes and producing wide range of frequency with uniform spread (Henry Azima, 1998). This allows for simple designs as single unit can cover wide frequency range. Produced sound
propagates evenly in all directions making it better at dealing with poor room acoustics. The main disadvantages of panel speakers are weak bass reproduction, frequency fluctuation and artefacts such as ringing.

Aims and Objectives:

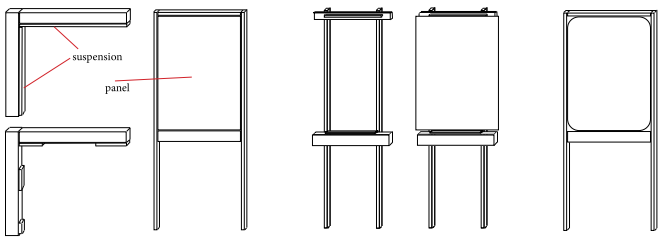
The aim of this project is to build cost effective loudspeaker with flat frequency response and extended low-end. The sound produced by the prototype should have good quality and include no ringing or other audible artefacts.
The objectives are:

- Research technology to find important qualities for components and materials and how to apply them
- Research market for availability and order parts accordingly
- Design panel for two different types of material
- Design different types of framing/support
- Build and test prototype designs and compare their results
- Apply further improvements and test their effect

Methodology:

Designs were produced based on materials available and research. Exciter should have lowest possible resonant frequency as it determines DML's low-end performance (David A. Anderson, Michael C. Heilemann, Mark F. Bocko, 2017). Panel material needs to be as rigid and light as possible to improve its effectiveness and somewhat dampened to avoid ringing (Henry Azima, 1997). Ratios of height to width should be designed unevenly to cause decorelation of waves (Graham Bank, 2001). Same principal can be applied to positioning of exciter on a plate. Performance can be further improved by rounding corners and applying different framing/support methods (James A. S. Angus, 2000). These findings led to two panel designs, rectangular and rounded for each of two materials, plywood and gatorfoam, using three different framing/support designs, unclamped, clamped and partially clamped. All designs need to be tested for frequency response.

Designs:

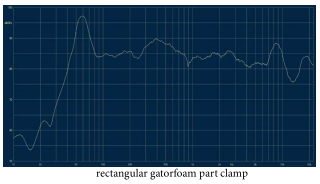


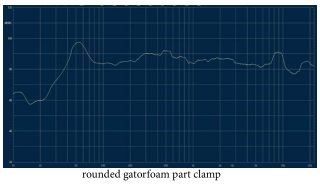
Clamped and partially clamped design

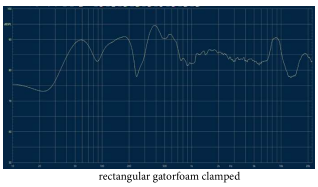
Unclamped design with panel resting on suspension

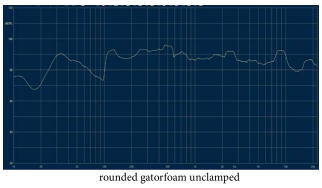
Panel with rounded edges

Testing:


rectangular gatorfoam part clamp


rounded gatorfoam part clamp


rectangular gatorfoam clamped


rounded gatorfoam unclamped

Conclusion:

Testing results clearly show improvement of partial clamping over unclamped and fully clamped and slight improvement after rounding edges. Final design which is rounded gatorfoam partially clamped does not meet the project aim fully, however, it is very close to it. Listening tests revealed the speaker sounds pleasant without any ringing, the only issue being the bass sound not powerful enough. With some improvements and more testing it could be possible to achieve better performance.

References:

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