The Reduction in Size of a Point Source

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Abstract

In order to be classified a point source, the source must not be relative in size to the space it is measuring. Commercially available sources are too large for spaces such as vehicle cabins. To solve this problem the volume of the source needs to be reduced. With the reduction of size, the source increases in portability. The most common source is in the shape of a dodecahedron, other forms of source are possible to create a spherical wave, each with their own limitations. From this research a miniaturised source is created.

Introduction

A point source is required to be ignorable in size in relation to the distance between the measured object and the measurement point (Miura, Muraoka and Ifukube, 2010). Within large spaces the current dodecahedron is suitable; measuring spaces that are smaller in dimension may find that the dodecahedron source is no longer considerable as ignorable in size.

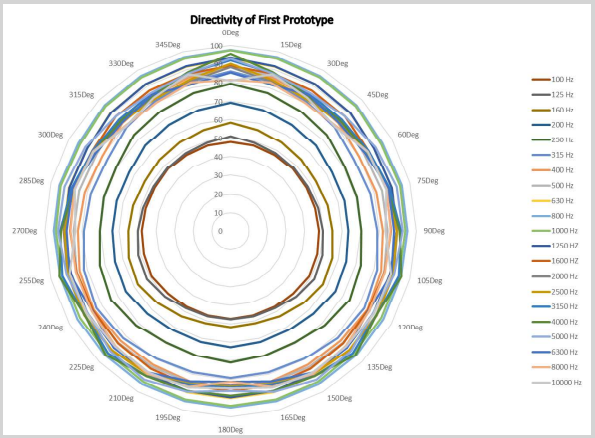
Beyond a conventional polyhedral source such as the dodecahedron, there are other methods of generating a spherical wave. One of which is known as a reversely attached horn. Another method uses two drivers either back to back or face to face and run together to create a spherical wave. This method works well for low frequencies down to the driver's lowest ability.
Out of all methods, polyhedral appears to be the most common occurring. The use of 3D printing for prototyping is a seemingly sensible option. This method of manufacture is flexible in terms of materials used, shapes produced, part density and other factors. Whilst changing multiple factors could influence the final source performance.

Methodology

A polyhedral source method was chosen based upon research. In order to create the source, CAD is used to allow the creation of models. The chosen CAD package for the design stage is Fusion 360. With the initial prototype created, a functional version was drawn up for use with Visaton K50 WP drivers. With the source created, it was soldered together in series of 3 in parallel with each other giving a 6Ω impedance.

With the 50mm driver source measured, two more sources were created with unknown drivers. One with 25mm drivers and one using 10mm drivers. When it came to testing the 25mm driver source was measured showing a poor response, meaning further tests were not carried out.

Measurements



The prototype source does not fall in the requirements set by ISO 3382-1:2009. When measured, the source used a basic pink noise file with no alterations to the equalisation. The deviance is around ±2dB where it should be ±1dB. The drivers used were not checked to be equal in performance before the source was put together.
From 315Hz – 10kHz the source is operating above 80dB @0.5m allowing for equalisation to flatten the peaks caused by resonances. The low frequency performance is however poor with 100Hz dropping to 40dB @0.5m

Conclusions

To create the best approximation of an omnidirectional source throughout 360°, is to use a polyhedral structure. Whilst there are other methods to create an omnidirectional source, they can be limited to ±90°, like the inverse horn approach.

By reducing the driver size there are both positive and negative effects; smaller drivers allow for a small chassis along with a lower mass, increasing the portability of the source.
The smaller drivers have a low excursion and low power, these factors contribute to the poor low frequency performance of the source.

References

MIURA, T., T. MURAOKA, and T. IFUKUBE, Nov 4, 2010. Point-Source Loudspeaker Reversely Attached Acoustic Horn: Improvement of Acoustic Characteristics and Application to Some Measurements. AES

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