# Double Bass Array in L-shaped Room

## Content

# Motivation

It will be investigated whether the principle of the double bass array can be applied to an L-shaped room.

# Theory

## Problem

A traditional DBA arrangement does not work in an L-shaped space because the plane wave diffracts around the edge and thus loses its shape. The rear grid is then no longer able to build up a coherent, inverted wave front. The goal now is to reshape the wave front so that it matches the cancelling one.

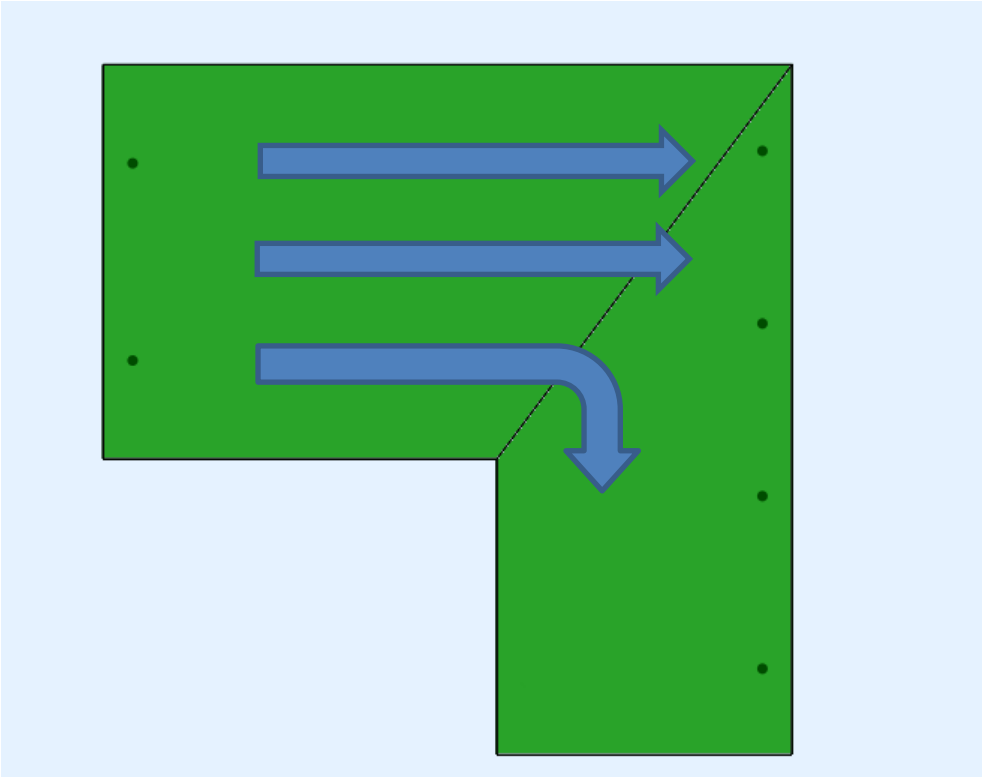

Illustration 1: Diffraction of the wavefront around corner

## Solution

Basically, an L-shaped room can be considered as a cuboid one, where a cuboid piece has been filled with mass (see Illustration 2). The idea is to first generate the plane wave in one of the branches through p*rimary sound sources*. As soon as the wave reaches the end of the filled area of space (i.e., the inner corner of the L), *secondary sound sources* complete the wavefront. Thus, when the plane wave hits the back wall, it can be cancelled out by an inverted and time-delayed array.

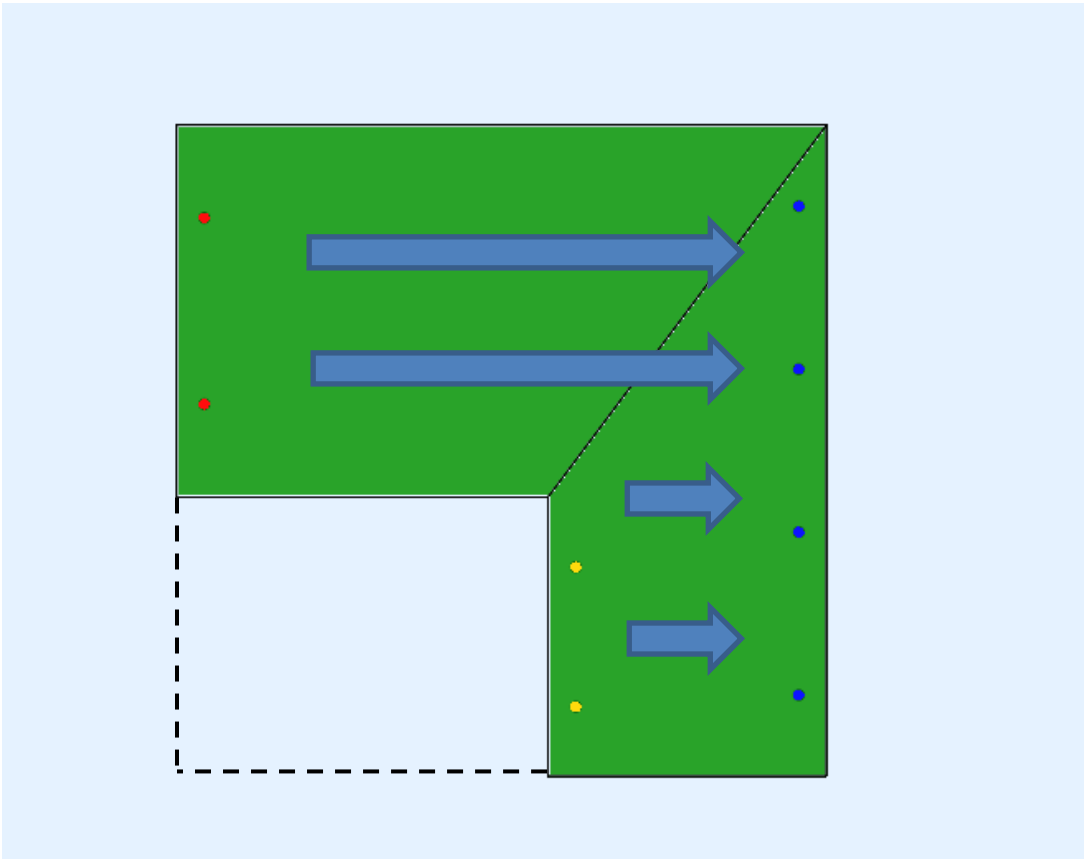

Illustration 2: Primary, Secondary and Cancelling Sound Sources

Red: create the plane wave

Yellow: complete the plane wave when it reaches the inner corner

Blue: cancel out the plane wave

## Simulation

The simulations were performed with ABEC. The large branch of the L-shaped room is 4 m long and 4 m wide. The small branch is 3 m long and 3 m wide. The longest edge is therefore 7 m long.

The measuring points are distributed in both branches (smaller points).

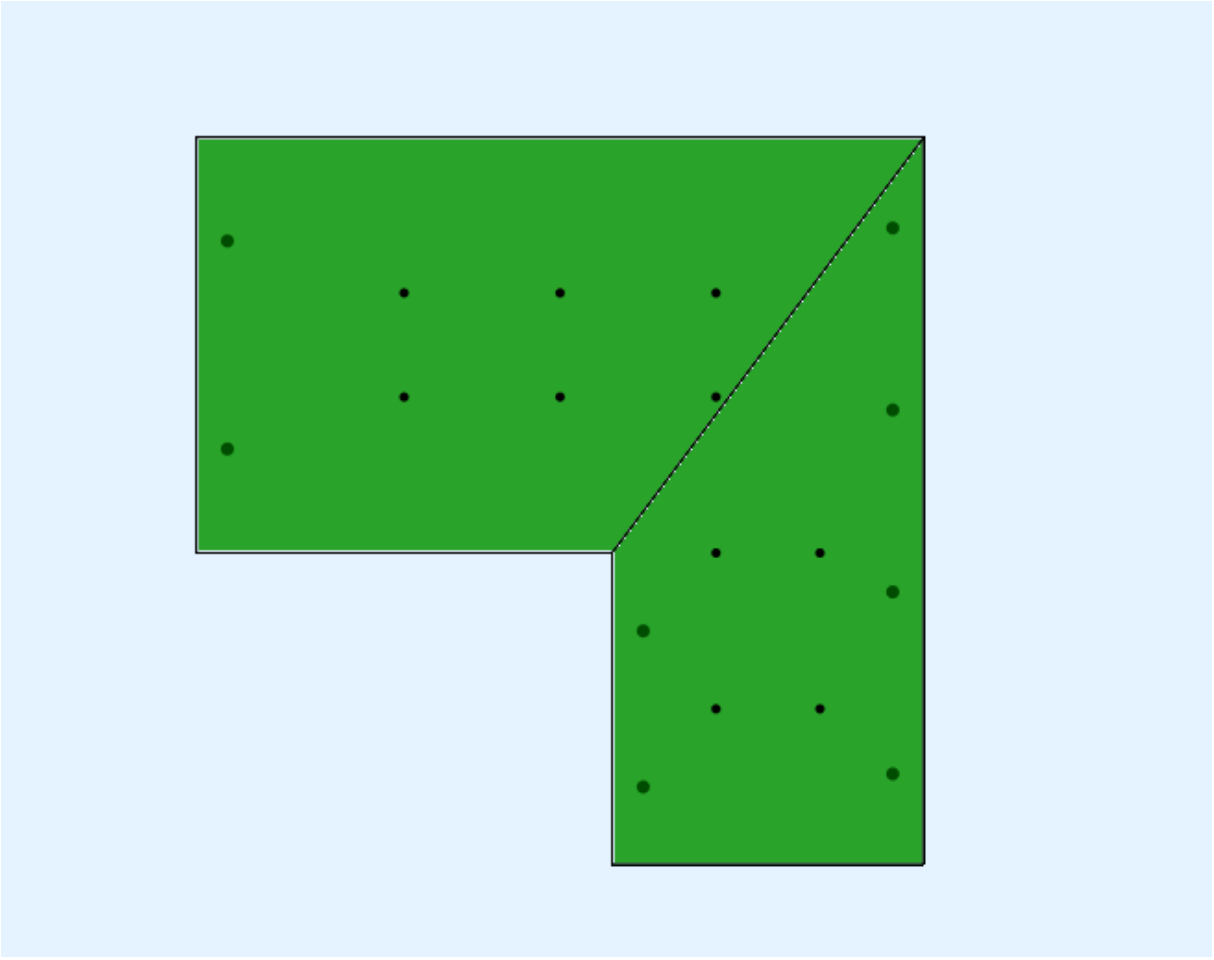

Figure 3: L-shaped room with 8 sound sources and 10 measurement positions

In order for the wavefront to be completed, the secondary sound sources must be delayed by the time it takes for the sound to reach the L-corner. The signal of the rear grid is delayed by the entire length, as in a cuboid room.

Furthermore, the signal level of the secondary sound sources must be iteratively adjusted to achieve the best result. The following values were determined to be optimal in the simulation.

**Secondary sound sources:**

- *Delay: 11.4 ms*
- *Signal level: 0.72 based on front grid*

**Cancelling sound sources:**

- *Delay: 20.4 ms*
- *Signal level: -0.75 based on front grid*

The following diagram shows the amplitude responses at the 10 measurement positions. As you can see, the sound pressure level is almost constant over the entire room and the variances are very low.

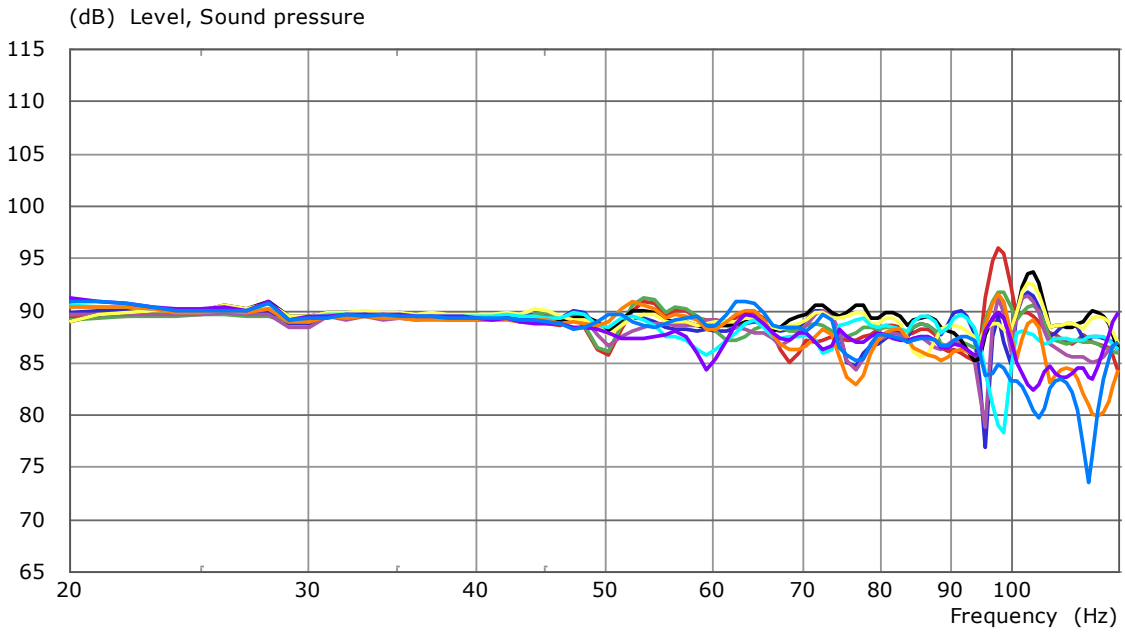


Figure 4: Amplitude Responses at the Measurement Positions

As an example, the sound pressure level in the 1st longitudinal mode (24 Hz) is shown here. The level is virtually constant throughout the room. There is no effect of the mode. The DBA works.

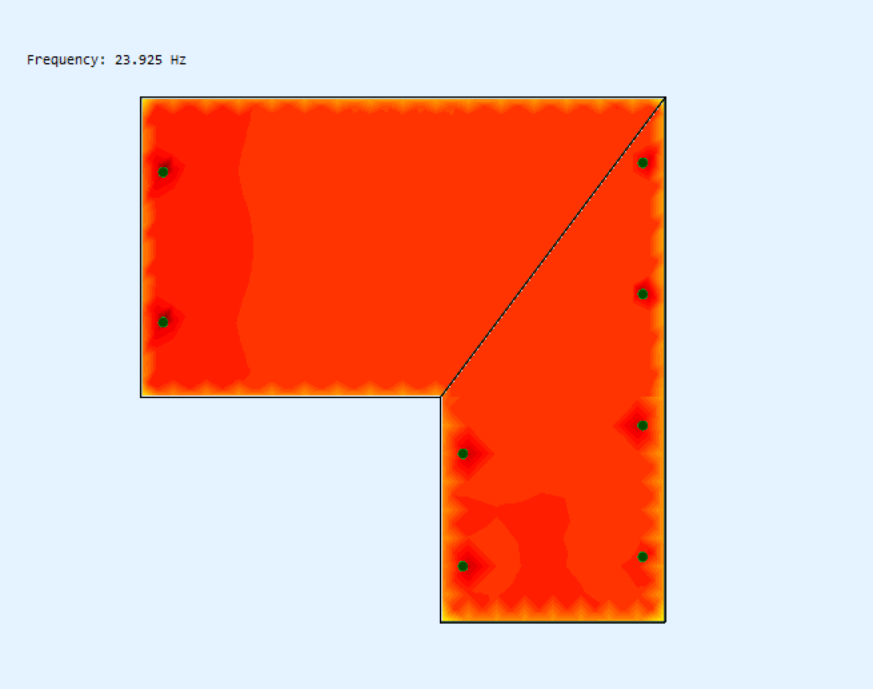


Figure 5: 1. Longitudinal mode (approx. 24 Hz) throughout the room

## Result

It was possible to develop a systematic subwoofer arrangement for L-shaped rooms. The simulation shows how well this works throughout the room. The number of actual drivers, as with any DBA, depends heavily on the dimensions of the room.

The only disadvantage of this arrangement is the need of the additional delay for the secondary sound sources. So, a total of two different delays are needed. A simple stereo DSP will suffice. In addition, the system should be equalized over everything, so that a total of three DSP channels are advisable.