DSA
DIGITAL STEERING VS. PHYSICAL AIMING

INTRODUCTION

This article describes the most unusual and beneficial acoustical feature of DSA loudspeakers. To make the concept easier to understand, assume the loudspeaker being discussed has a horizontal coverage pattern of 180 degrees (+/-90 degrees off-axis). Refer to the various diagrams as you read this article. Figures 1 to 4 are schematic 2-D drawings of the room shown in Figures 5 and 6. The digital steering performance being discussed works the same way regardless of the how the variable beamwidth, the other primary DSA parameter, is adjusted.

THE BASIC IDEA

Digital steering works differently than physically aiming a loudspeaker with the same nominal beamwidth. The basic digital steering mechanism involves progressively adding more signal delay to the drivers in the DSA loudspeaker from the top to bottom. The size of the delay "steps" determines the steering angle.

DIGITAL VS. PHYSICAL STEERING ON AXIS

Normally, the loudspeaker would be physically aimed downwards. The listener in the rear center of the seating is thus "on-axis", on-axis being perpendicular to the plane of the drivers.

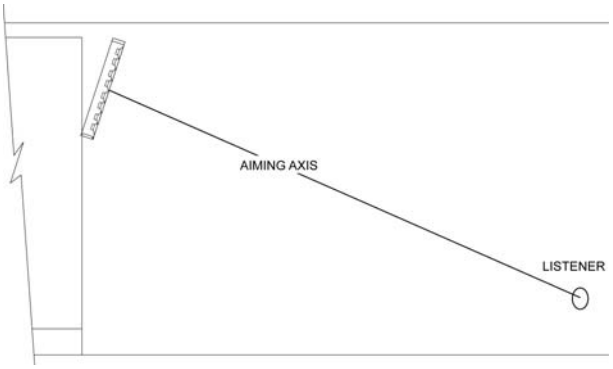

FIGURE 1: PHYSICAL STEERING AT 0 DEGREES

Figure 1: Looking from the side of the room, this is how the tilted loudspeaker appears physically and acoustically at 0 degrees on axis.

Now, assume a listener in this same location but the loudspeaker is digitally steered. Because it is mounted flat to the proscenium, it appears to the listener to be physically aimed straight out to the back wall. However, using a different amount of signal delay to each driver, we can "move" the lower drivers further backwards from the listener than the upper drivers. The acoustic output thus appears as if it is from a loudspeaker that is physically tilted downwards.

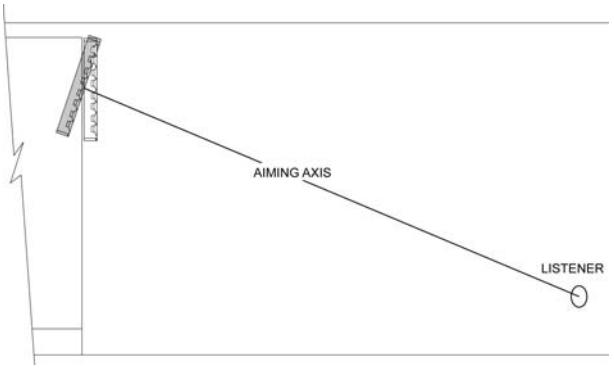

FIGURE 2: DIGITAL STEERING AT 0 DEGREES

Figure 2: Looking from the side of the room, the outlined loudspeaker is the physical position of the loudspeaker. The angled gray loudspeaker is how it appears acoustically 0 degrees on axis.

Compare Figures 1 and 2. The grayed digitally steered loudspeaker in Figure 2 looks like the physically tilted loudspeaker in Figure 1. Thus, for listening areas directly in front of the loudspeaker, digitally steering and physically tilting the loudspeaker can produce similar results.

DIGITAL VS. PHYSICAL STEERING OFF AXIS

Now, imagine a listener in the end of the front row of seats, almost 90 degrees off-axis from the loudspeaker that is physically tilted downwards. From this location, the loudspeaker is NOT tilted downwards. In fact, the side of the loudspeaker is parallel to the walls and thus is aimed directly at the sidewalls. By physically tilting the loudspeaker, the downward aiming angle becomes less the further off-axis you are. At 90 degrees off-axis, this angle is essentially 0 degrees.

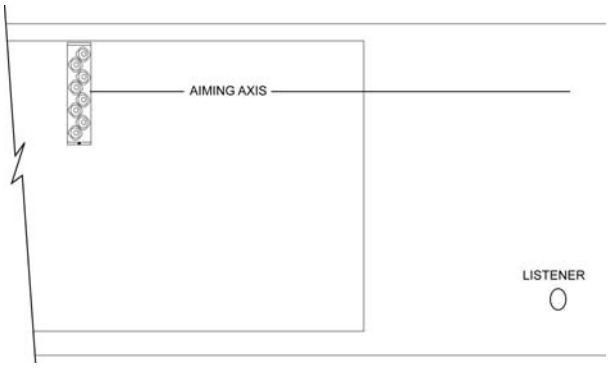

FIGURE 3: PHYSICAL STEERING AT 90 DEGREESS

Figure 3: Looking towards the front of the room from the rear, the tilted loudspeaker is NOT aimed at the side listener. This is how it appears both physically and acoustically at 90 degrees off-axis.

The digitally steered loudspeaker in this side listening position performs differently. Note that because it is physically mounted vertically, from either the front or sides all the drivers are at the same distance and angle to the listener. Thus with the same delay settings to each driver, the acoustic aiming remains unchanged. This means the downward aiming angle of the loudspeaker's output is the same at 90 degrees off axis as it is on-axis.

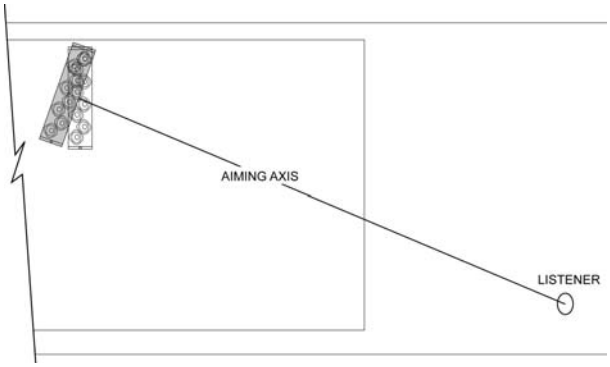

FIGURE 4: DIGITAL STEERING AT 90 DEGREES

Figure 4: Looking towards the front of the room from the rear, the digitally steered loudspeaker is aimed at the side listener. The outlined vertical loudspeaker is the physical position of the loudspeaker. The angled gray loudspeaker is how it appears acoustically at 90 degrees off-axis.

Compare Figures 2 and 4. The two grayed loudspeakers look the same (except for the expected physical difference between seeing the front and side of the loudspeaker).

SUMMARY

The result of physically tilting the loudspeaker is that the downward aiming angle to the listener changes as you move off axis. Contrarily, the downward aiming angle for the digitally steered loudspeaker does not change as you move off axis. The resulting coverage patterns for the listeners are quite different, with digital steering providing significantly better results. Figures 5 and 6 are EASE plots that show a 3-dimensional view of this difference. A DSA230 loudspeaker was used for both plots. The lighter areas represent good coverage the darker areas poor coverage. The SPLs listed in these plots are not the maximum SPLs for a DSA230. They are only listed to compare levels between the two diagrams.

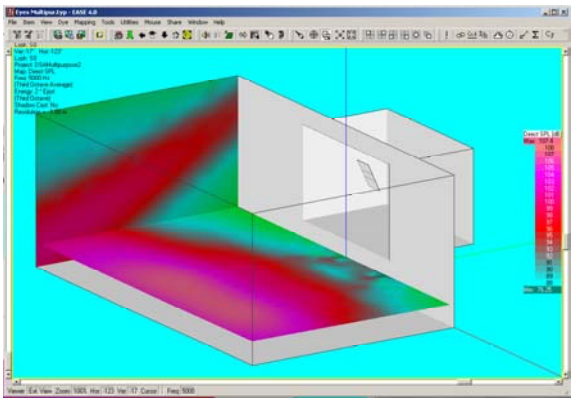

FIGURE 5: DSA230 TILTED DOWN

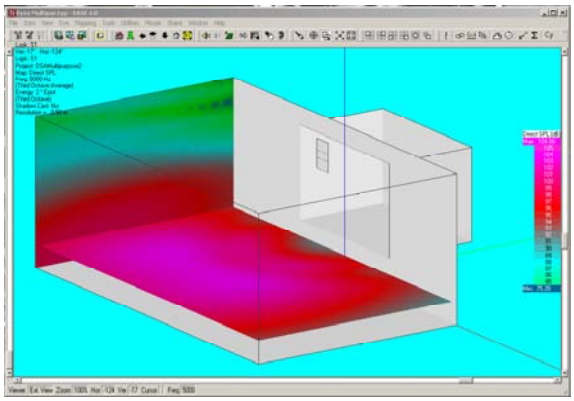

FIGURE 6: DSA230 DIGITALLY STEERED DOWN