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OVERHEAD CANOPY DESIGN

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The Shape Optimizer produces a large amount of sound pressure level data, as was shown in dbv1i10 for a given source position in the middle of the stage and for a given frequency, namely 2 kHz. Since we need to evaluate the uniformity of the scattered pressure at 1/3-octave intervals over the bandwidth of interest, at all receivers from all sources, we must find a way to condense this information. All of the sound pressure level distributions versus frequency can be condensed into a single plot of standard deviation versus frequency, as described in AES-4id-2001 and shown in Figure 1.

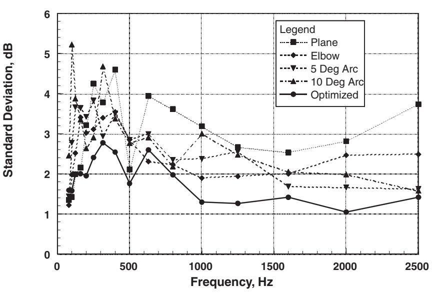

Figure 1. The standard deviation from a mean sound pressure level is plotted for all of the potential shapes. For the spaced canopy elements, the optimized surface has the smallest deviation, meaning greatest uniformity.

Forestage Optimization

The Shape Optimizer can also be used to optimize the forestage area, as well as the coverage on stage. In Figure 2, we show the stage and forestage areas, along with

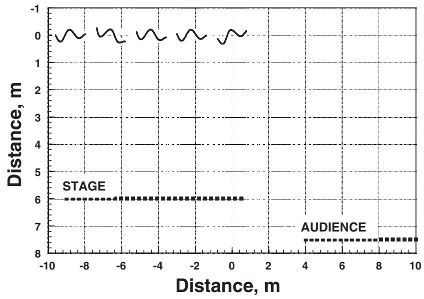

Figure 2. Cross section of the canopy used in the optimization study. Canopy elements run the full width of the stage.

an array of similar, spaced, optimized shape canopy elements. Each canopy element can be individually tilted for optimum coverage on stage and to produce the desired distribution of stage-generated energy between stage and audience. The canopy elements extend across the full width of the stage and are spaced for lighting or to access the volume above the canopy. In this optimization, we specified that the scattered energy should be as uniform as possible on stage (-9 - 0 m) and in the audience area between 4 and 10 m from the edge of the stage. In addition, we searched for the best shape and orientation to reduce the level in the audience by 3 dB of what it is on stage. To accomplish this, the Shape Optimizer™ varies the shape and tilt of the 5 individual canopy elements. At each iteration of the optimization, the standard deviation of the scattered pressure, indicated in Figure 1 for a source at the rear of the stage and at 1 KHz, is monitored as an indicator of performance. The Shape Optimizer™ cycles until it finds the best shape and tilts that yield the lowest standard deviation in the specified bandwidth (i.e. 100 to 3,000 Hz) at all observer positions, from all source positions.

In Figure 3, we show the scattered sound pressure at 1 kHz from a flat canopy (thin line) versus an optimized canopy (thick line-circle). The flat canopy exhibits sig-

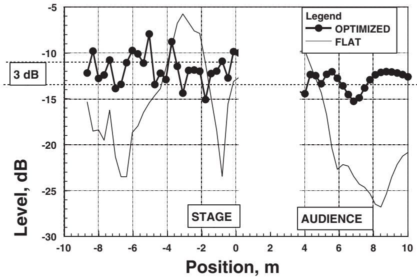

Figure 3.. Comparison of the sound pressure level on stage and in the audience at 1 kHz, for a source at the rear of the stage, for a flat and optimized canopy.

nificant fluctuations both on stage and in the audience area of interest. The optimized canopy, on the other hand, displays a more uniform response.

It is important to mention that the criterion given of even energy across the stage, while appropriate for spaced arrays, may not always be considered to be the best for all cases. Consider a canopy with a small

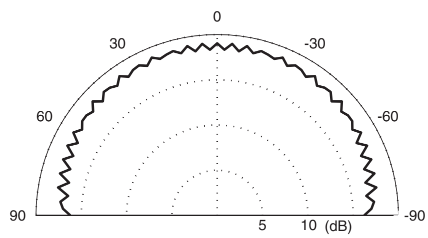

Figure 4. Uniform far field spatial coverage

open area, in other words a large surface the same width and depth as the stage. A flat surface will give very good coverage on the stage, however, strong specular reflections may result. The desire here is to promote temporal diffusion to minimize the effects of harsh overhead reflections, which are strong and similar to the direct sound. Consequently, it is better in this case to design a stage canopy to promote maximum dispersion from the array across a complete arc from -90 to +90^0 in the far field. Uniform spatial and temporal dispersion from the overhead canopy will minimize coloration effects.