MAPP Online Accuracy Confirmed by Test of Predicted Response

Why did Meyer Sound create MAPP Online?

In theory, predictive acoustical modeling can be a very useful tool for sound system designers. But if a predictive model of frequency response differs substantially from the actual response of the installed system, then not only is the prediction of little practical use, but also it may actually prove to be misleading. To assure accurate, reliable sound system modeling, Meyer Sound developed MAPP (Multipurpose Acoustical Prediction Program) Online —a powerful, cross-platform, Internet-enabled tool that accurately predicts the coverage pattern, frequency response, impulse response and maximum SPL output of arrayed Meyer Sound loudspeakers.

Because MAPP Online is intended to be a tool for audio industry professionals to use in specifying loudspeaker systems that must meet stringent real-world performance guarantees, Meyer Sound deemed it vital to prove the program's accuracy through equally stringent empirical testing. This description of a testing session is excerpted from an interactive technical paper (available at www.meyersound.com) titled "Comparison of MAPP Online Frequency Response Prediction with Measured Response of a Physical System."

How MAPP Online works

To make the power of MAPP available for a wide user base, Meyer Sound set up the program as an Internet-based solution, allowing users worldwide to access the company's powerful central servers for the "number crunching" while viewing the results on their local computers.

Here's how it works: MAPP Online comprises two software components: a Java application residing on the sound system designer's computer, and a sophisticated acoustical prediction algorithm running on a remote, high-powered server. Using the Java application, the system designer specifies arrays of Meyer Sound products and, optionally, defines the environment in which they will operate, including air temperature, pressure and humidity, as well as the location and composition of walls.

When the designer requests a prediction, the Java application sends sound system configuration data over the Internet to the server computer. The server generates the prediction using high-resolution, complex (magnitude and phase) polar data, then returns the results to the local host for display in color. Predictions can be stored for further analysis and comparison with measurements of the installed system.

Testing for accuracy

For an empirical test of MAPP Online's accuracy, research and development personnel at Meyer Sound obtained use of a representative concert hall where they could hang a loudspeaker array and then compare actual measured performance with predictions made by MAPP Online.

Figure 1: Loudspeaker arrays installed in the test venue

The auditorium used for the testing was the University of California at Berkeley's Zellerbach Hall, chosen because it is representative of the room size and acoustical conditions that sound system designers are likely to encounter. The 2014-seat venue regularly hosts performances ranging from classical chamber ensembles to amplified popular music.

As shown in Figure 1, multiple loudspeaker arrays comprising various Meyer Sound products were rigged for testing. Here, we will be concerned only with the array of six M2D Compact

Curvilinear Array loudspeakers and one M2D-Sub Compact subwoofer suspended from trusses at the approximate center of the stage, as shown in the upper right corner of Figure 1. For the measurements shown here, the research team placed a calibrated microphone in the hall approximately forty feet from the M2D array.

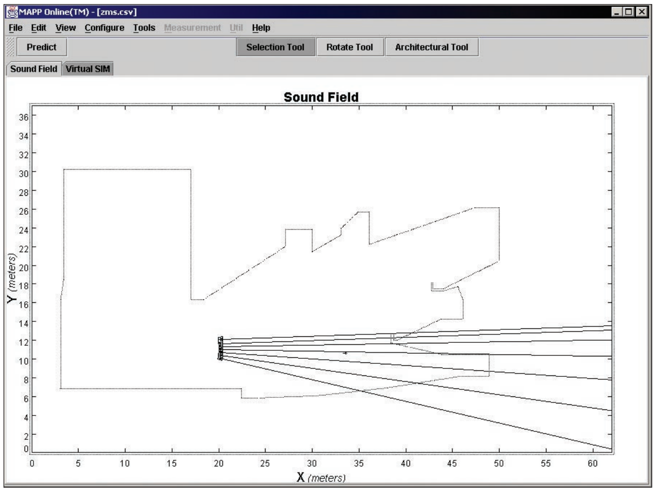

Figure 2: M2D Array in Zellerbach Hall as Modeled in MAPP

Before taking measurements, the Meyer Sound team modeled the test array in the MAPP Online client software. Figure 2 shows the MAPP Online model of the six M2D's and the M2D-Sub in side view. (The M2D Sub is "off" in this configuration file, as it was during testing.) Using the menu item "Loudspeaker Array" in the "Configure" menu, Meyer Sound engineers specified exact splay angles for the system.

Viewing the predicted results

Once the array is designed, clicking the "Predict" button in the upper left-hand corner of the MAPP Online window causes the Java client to connect with the computational computer in Berkeley and transmit the array data for analysis. (An active Internet connection is required to receive a prediction, but loudspeaker arrays and microphone positions can be defined offline prior to connecting.) After a few seconds, the local computer displays a color image similar to that shown in Figure 3. The colors indicate the predicted coverage pattern in the octave band centered at 500 Hz (the default octave). The octave band can be changed using the "Prediction Parameters" item in the "Configure" menu.

Clicking on the "Virtual SIM" tab *(see sidebar on page 3 for a description of SIM System II)* brings up the Virtual SIM view, which includes an estimate of the 1/3rd octave spectrum response, the frequency response (smoothed to 1/6th or 1/3rd octave, or unsmoothed), and the band-limited impulse response. Each view is available in the "MAPP Online Measurement" menu, and the smoothing and zoom options are found in the "Util" menu.

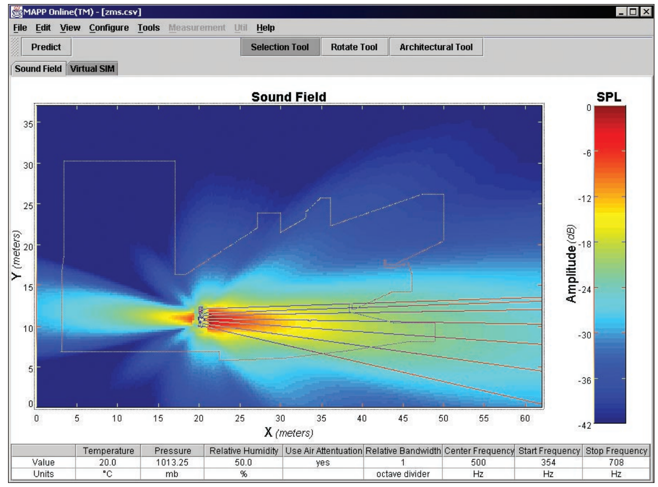

Figure 3: MAPP Online Sound Field Prediction

Figure 4 shows the 1/6th octave smoothed frequency response estimate of the Zellerbach system for the designated microphone position. Notice that MAPP Online accurately models the high-frequency attenuation caused by air, which varies with temperature, humidity, pressure and distance. These environmental parameters are available in the "Natural Environment" dialog appearing under the "Configure" menu.

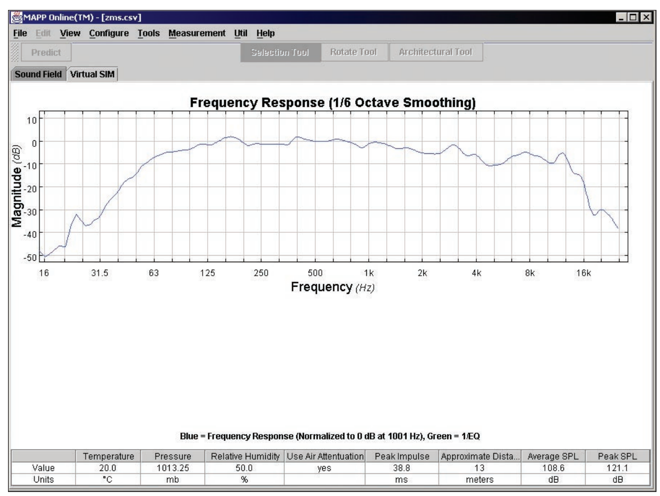

Figure 4: 1/6th Octave Smoothed Frequency Response as Estimated by MAPP Online

Accuracy of MAPP prediction verified

Using a SIM System II FFT Analyzer, Meyer Sound engineers measured the frequency response of the six M2Ds from the designated microphone position in Zellerbach Hall. Data from the SIM measurement were exported to the MatLab application for analysis, as was the Virtual SIM frequency response prediction. Figure 5 shows the two data sets overlayed in a single plot.

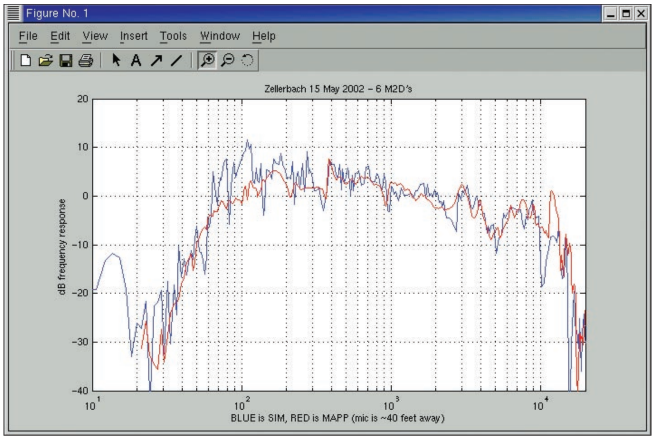

Figure 5: Predicted and Measured Frequency Response at 1/24th Octave Frequency Resolution

In Figure 5, the blue trace plots the actual measurement data, while the red trace shows the MAPP Online prediction. Overall, the match is excellent, most notably from about 150 Hz to 10KHz.

Below 150 Hz, the resonance effects of the room (which are not currently modeled in MAPP Online) contribute low-frequency buildup. Anomalies above 10 kHz — where the sound wavelengths are very short — are attributable to immediate boundary conditions, and will vary radically with small changes in the measurement position. Note, however, that MAPP Online very accurately predicts the general trend of the system response in these regions.

This comparison of the predicted and measured responses for the M2D curvilinear array of loudspeakers, rigged in a practical performance space, demonstrates that MAPP Online's predictions are highly accurate and may be relied upon in designing real systems. It is worth noting that MAPP Online is the only acoustical prediction program that yields reliable, high-resolution frequency response data, and that the program's predictions are remarkably accurate even when viewed at the finest frequency resolution. Among other benefits, this capability affords the opportunity to predetermine equalization and delay settings with great accuracy, assuring that installed systems will perform to specifications with minimal onsite adjustments.

A time and money saving tool

Thanks to its extraordinary accuracy, MAPP Online is a powerful tool for visualizing how individual and arrayed Meyer Sound loudspeakers will behave acoustically before committing to a physical installation. By using MAPP Online, the acoustical consultant or sound engineer can design a system that will assure satisfaction, even in demanding situations, in far less time than has previously been required. Furthermore, design-build contractors can bid on a system with confidence, knowing that it will perform precisely according to specifications, with no concerns about possible system additions or substantial modifications after initial installation. With equalization and delay settings predetermined, the system can be calibrated and aligned in less time and with greater accuracy. The result is optimized system performance without component "overkill", as well as faster system commissioning with little or no time wasted in re-rigging or re-aiming loudspeakers.

MAPP Online is available free of charge to qualified professionals. For more information, please visit www.meyersound.com.

SIM System II

SIM System II is a powerful instrumentation product line comprising the SIM‑ 2201 Sound Analyzer, SIM‑2403 Interface Network, and a selection of software options, microphones and accessory cables. In contrast to conventional two‑channel FFT analyzers, SIM System II presents optimal facilities for audio‑frequency measurements of an acoustical system, and facilitates precise, meaningful electronic corrections to adjust the system response.

The SIM‑2201 Sound Analyzer implements Meyer Sound's Source Independent Measurement technique, a dual‑channel method that accommodates statistically unpredictable test signals. With SIM, any excitation signal that encompasses the frequency range of interest — even intermittently — can provide sufficient information to obtain highly accurate measurements of an acoustical or electronic system. For example, a concert hall and its installed loudspeaker system may be characterized during a musical performance, using the sound of the voices and/or instruments as the test signal.

SIM System II displays measurement data as amplitude vs. time (Impulse Response), amplitude vs. frequency (Spectrum), or amplitude and phase vs. frequency (Frequency Response). Data that are plotted in the frequency domain (Spectrum and Frequency Response) display on a logarithmic horizontal axis that closely approximates the human ear's perception of musical pitch and timbre. A Delay Finder function measures, and internally compensates for, propagation delays.

MAPP Online's Virtual SIM function accurately predicts results that would be obtained by measuring the modeled loudspeaker system at a specified microphone location using SIM System II. It includes a Virtual VX‑1 Stereo Program Equalizer whose response overlays the Frequency Response trace in the 1/EQ mode familiar to SIM Operators.

Manipulating real‑time, onscreen controls, the sound system designer can accurately determine settings to optimize system frequency response. Upon installation of the system, the settings can be transfered to the controls of an equalizer to obtain closely optimized response in conditions where limitations may constrain onsite measurements.

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