Silent Equalization Using Smaart Software

Silent equalization is a technique where you adjust the EQ of a sound system without using loud test signals, instead relying on lower-volume audio content or the existing program material. This method is particularly useful in environments where generating loud pink noise or sine sweeps would be disruptive, such as in live venues, theaters, or public spaces.

1. Understanding Silent Equalization

Silent equalization focuses on using low-level signals or actual program material (like music or speech) to analyze and adjust the sound system's frequency response. This approach leverages the advanced capabilities of Smaart software, which can accurately analyze audio even at low levels.

- **Advantages**:
    - **Non-intrusive**: Ideal for tuning systems in environments where loud test tones would be disruptive.
    - **Real-world Relevance**: Uses actual program material, giving a more accurate representation of how the system will perform during use.
- **Challenges**:
    - **Lower Signal-to-Noise Ratio (SNR)**: Low-level signals can be closer to the ambient noise floor, potentially affecting the accuracy of measurements.
    - **Less Precision**: Without the controlled, consistent signal of test tones, adjustments may need to be more generalized.

2. Equipment and Environment Setup

a. Smaart Software and Computer Setup

- **Smaart Version**: Ensure you are using a version of Smaart that supports RTA (Real-Time Analyzer) and Transfer Function modes.
- **Audio Interface**: A high-quality audio interface with low noise and good dynamic range is crucial for capturing accurate measurements at low levels.
    - **Example**: RME Babyface Pro or Focusrite Scarlett interfaces are commonly used for their reliability and performance.
- **Computer Requirements**: The computer should have sufficient processing power and memory to handle real-time analysis without lag.

b. Measurement Microphone

- **Type**: Use a flat-response, omnidirectional measurement microphone, such as those from Earthworks or Brüel & Kjær (B&K).
- **Calibration**: Before starting, calibrate the microphone using a sound level calibrator to ensure it's capturing accurate SPL levels.
    - **Calibration Process**: Typically, you'll set the calibrator to 94 dB SPL at 1 kHz, attach it to the microphone, and input the calibration data into Smaart.

c. Acoustic Environment

- **Location**: Ideally, measurements should be conducted in a controlled environment like a live venue, theater, or any space where the sound system will be used.
- **Ambient Noise Considerations**: Since silent equalization relies on low-level signals, minimize ambient noise as much as possible. Close doors, turn off HVAC systems, and limit movement during measurements.
- **Microphone Placement**:
    - **Primary Listening Position**: Position the microphone at the main listening area (e.g., FOH mixing position in a live venue).
    - **Multiple Positions (Optional)**: For systems covering larger areas, take measurements at several key listening positions to average the response across the audience area.

3. Signal Generation and Analysis

a. Choosing the Reference Material

- **Program Material**: Select a well-recorded track that covers a wide frequency range, with clear bass, mids, and highs. This helps ensure a balanced analysis.
    - **Examples**: Use reference tracks like "Hotel California" by Eagles or “Another One Bites the Dust” by Queen, known for their wide frequency range and dynamic content.
- **Low-Level Pink Noise (Optional)**: If you prefer a more controlled signal, use low-level pink noise. Ensure it’s not loud enough to be disruptive but sufficient for Smaart to analyze.

b. Smaart RTA (Real-Time Analyzer) Mode

- **Setting Up RTA**:
    - **Input Source**: Select the measurement microphone as the input source in Smaart.
    - **Resolution**: Set the frequency resolution to a detailed level, such as 1/24th octave, for a fine-grained view of the system’s response.
    - **Time Averaging**: Enable time averaging (e.g., 10-second averaging) to smooth out short-term fluctuations and focus on the overall response.
- **Running the Analysis**:
    - Play the selected program material or pink noise through the sound system.
    - Monitor the RTA display in Smaart, watching for any frequency imbalances such as peaks or dips.

c. Smaart Transfer Function (Advanced)

- **Purpose**: The transfer function allows you to compare the output of the system (measured by the microphone) to the input signal (the original audio source), giving a direct view of how the system alters the signal.

- **Setting Up**:
    - Configure one input channel for the reference signal (e.g., direct output from the playback device).
    - Configure another input channel for the measurement microphone.
- **Running the Transfer Function**:
    - Smaart will display the difference between the reference signal and the measured output, showing how the system is coloring the sound.

4. Equalization Process

a. Interpreting the Data

- **RTA Insights**:
    - **Peaks**: Identify frequency bands where the SPL is higher than the rest. These indicate areas that may require attenuation.
    - **Dips**: Note any frequency bands where the SPL is lower. These may require a boost or could indicate room-related issues that may not be fixable with EQ alone.
- **Transfer Function Insights**:
    - **Phase Response**: The transfer function also shows phase differences between the input and output. Large phase shifts can indicate potential problems, especially in crossover regions or with subwoofer integration.

b. Applying EQ Adjustments

- **Using DSP or External EQ**:
    - Access the system's DSP (Digital Signal Processor) or an external equalizer.
    - Apply the necessary EQ adjustments based on the Smaart analysis. For example, if there's a peak at 3 kHz, apply a narrow cut in that range.
- **Types of EQ**:
    - **Parametric EQ**: Use parametric EQ for precise control over frequency, bandwidth (Q), and gain.
    - **Graphic EQ**: For broader adjustments, a graphic EQ can be used, though it's less flexible than parametric EQ.
- **Adjustment Strategy**:
    - **Start Broad**: Begin with broad adjustments to correct overall tonal imbalances.
    - **Fine-Tune**: After broad corrections, make finer adjustments to address specific issues.

c. Iterative Process

- **Reanalyze After Adjustments**: After making EQ changes, reanalyze the system using Smaart to see the effect of your adjustments.
- **Multiple Iterations**: It may take several iterations of measuring, adjusting, and remeasuring to achieve the desired balance.

5. Final Verification with Listening Tests

a. Critical Listening

- **Assess the System**: After making EQ adjustments based on the Smaart analysis, conduct a listening test using the same reference material. Focus on clarity, balance, and any remaining anomalies.
- **Check Across Different Materials**: Test with various types of content (e.g., music, speech) to ensure the EQ settings work well across the board.

b. Fine-Tuning Based on Listening

- **Make Additional Adjustments**: If necessary, make further small adjustments based on what you hear. Trust your ears, as the ultimate goal is a system that sounds good to the listener.
- **Recheck with Smaart**: If you make further adjustments, it's a good idea to recheck the system with Smaart to ensure you haven't introduced any new issues.

6. Documentation and Final Checks

a. Save EQ Settings

- **Document the EQ Settings**: Record the final EQ settings in the system's DSP or external EQ. This ensures you can recall or replicate the settings if needed.
- **Save Smaart Data**: Save the Smaart RTA and transfer function data for future reference or troubleshooting.

b. Revisit Environmental Factors

- **Check for Changes**: If the venue's environment changes (e.g., audience size, temperature), it might affect the system's performance. Recheck and adjust as necessary in different conditions.

Conclusion

Silent equalization using Smaart software is a powerful technique that allows you to fine-tune a sound system without disturbing the environment. It requires careful setup, a good understanding of the system's response, and iterative adjustments based on both measurements and critical listening. By leveraging Smaart's advanced analysis tools, you can achieve a balanced and accurate sound system that performs well under real-world conditions.