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Control Room Acoustics for the Home Studio

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Background

Reflection: Sound reflects off walls and can reach the listener. This creates echoes which can be more problematic in rooms with parallel walls.

Diffusion: Ideally, sound is evenly distributed throughout a room. However, this rarely happens without treatment. Poor diffusion causes comb-filtering.

Absorption: Different materials transfer sound energy to heat energy with varying efficiency. It is this phenomenon that affects the “deadening” of sound in spaces with highly absorbent materials.

Room Modes: Enclosed spaces act as resonators at low frequencies. This creates ringing of certain low frequencies and cancellation of others.

Schroeder Frequency: Under this frequency, a room acts as a resonator and room modes reign supreme.

Comb Filtering: Due to constructive and destructive interference, peaks and valleys in frequency response can be observed everywhere in the frequency spectrum.

Experimental Methods

For the untreated room tests, a Behringer ECM 8000 measurement microphone was placed where an audio engineer would typically be sitting. The measurement was then taken using a free program, Room EQ Wizard (REW). A sine wave sweep from 20Hz to 20,000Hz was ran through the stereo speakers used to mix on and the measurement mic captured the direct sound along with the reflected sound from the room. From there, REW generated graphs that could be compared to the data that the professor provided from his treated home studio.

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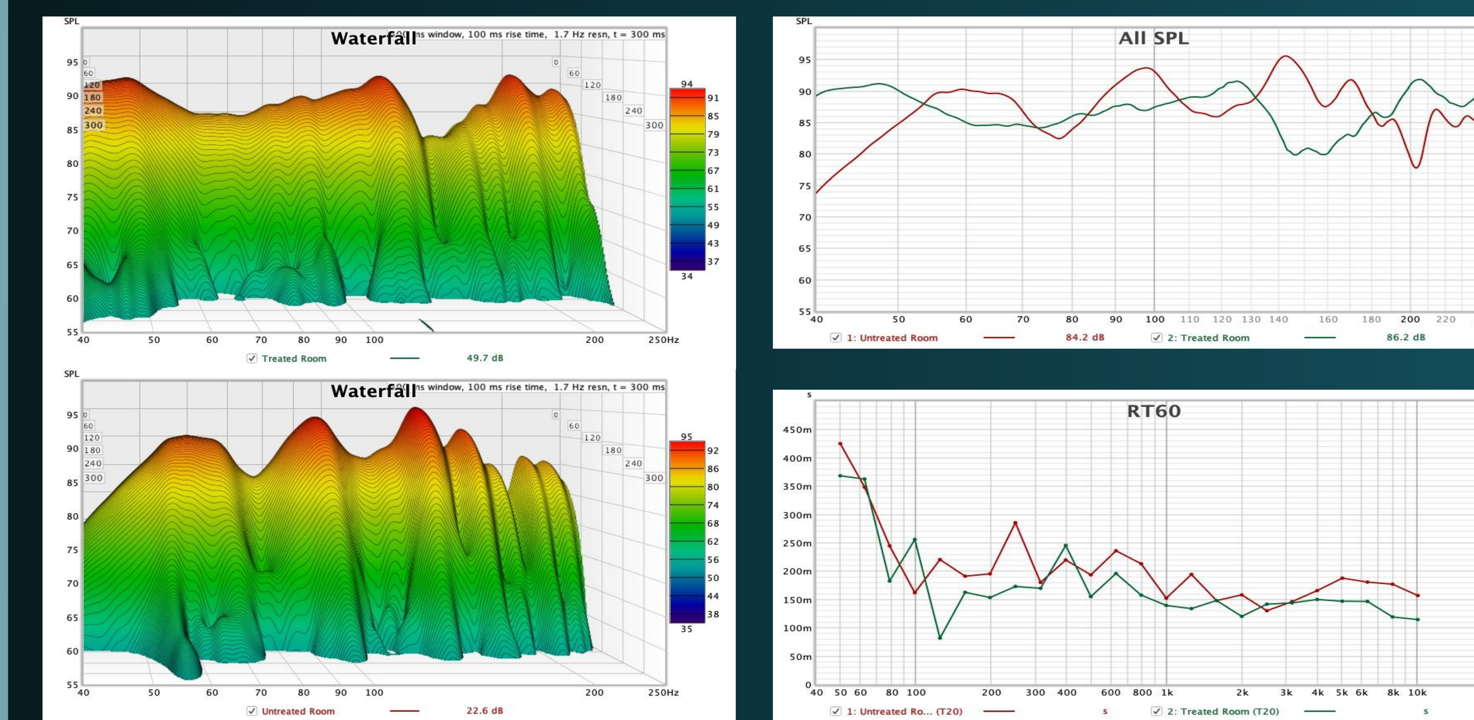
As recorded music becomes less costly to make, more aspiring audio engineers are working from their personal home studios. These are often spare bedrooms or basements that are repurposed for purposes of recording, monitoring, and mixing. While the inaccuracies of a room’s sound often can be mitigated during recording by using close-micing techniques, the same cannot be said for monitoring. The sound of a room plays an integral part in determining what, and with what accuracy, audio engineers can hear while they mix. Here, measurements of an untreated bedroom are compared with those of a similar room that has undergone acoustic treatment and possible forms of treatment are proposed.

Solutions

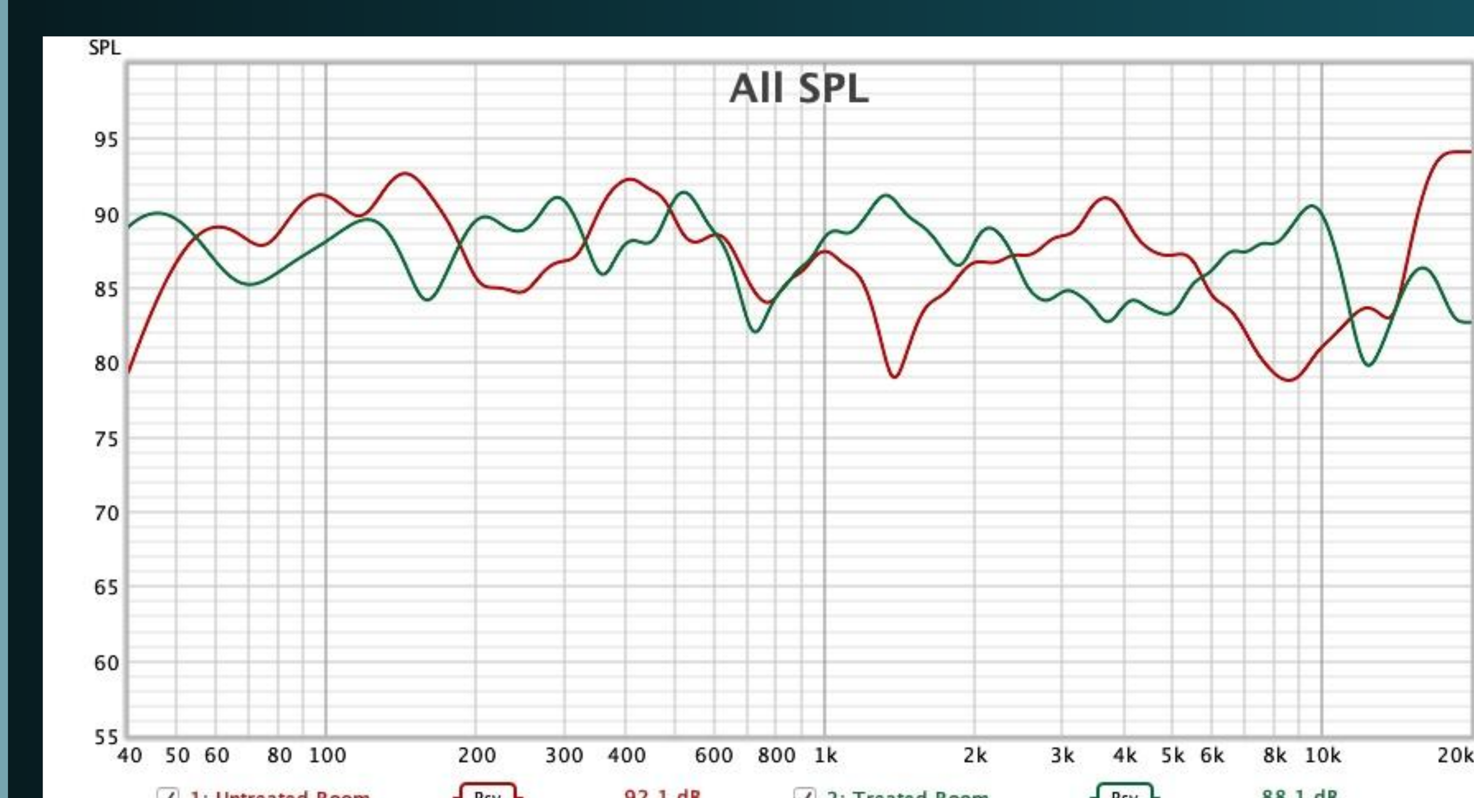
Room Modes: As seen from the top four graphs, room modes cause problems in low frequencies for untreated spaces and treated spaces alike. Bass traps can be placed in the corners of rooms to help mitigate these problems, but in order for these to effectively fix problems in the subbass frequencies, they have to have a depth of over 5 feet, which not every room has the space for.

Comb Filtering: Problems in the mids and highs can be helped with sound absorption, but diffuser panels can also be placed on the back wall of these rooms to lessen the comb-filtering effects that plague the midrange and high frequencies of untreated rooms.

Findings



On the left are two waterfall graphs, the top being of the professor’s treated room and the bottom being of an untreated bedroom studio. Room modes cause certain low frequencies to resonate and ring out. One of these modes in the untreated room can be seen at around 57Hz on the bottom graph, whereas no such pronounced resonances exist in the treated room. The untreated room also has a highly irregular frequency response as seen on the top-right graph, especially under 100Hz when compared to the professor’s room. This is an example of how low frequencies are often the most in need of treatment in home studios. Yet another example of this is shown in the reverberation time graph on the bottom right. Reverb times are consistently higher in the untreated room, but this difference is even more pronounced in frequencies under 300Hz. This “bass rise” in the reverberation time can be attributed to untreated room modes, causing the room to act as a resonator at low frequencies below the Schroeder Frequency.



Here, we see that frequency response fluctuations are not limited to just bass frequencies. Due to poor diffusion in the untreated room, comb-filtering causes irregularities in response all throughout the frequency spectrum. One particular problem is the pronounced dip in sound pressure level at around 1.4kHz. Frequencies around that area are often some of the most important when mixing, as many lead-elements in the mix (such as vocals) are dominant in those ranges. Another problem is the accentuation of the frequencies around 3.7kHz in the untreated room, as humans are extremely sensitive to those frequencies and thus they are important to manage in any mixing situation.