Virtual Education Lab: Potential specular reflection interference in a recording studio control room

From an analysis of measured and simulated high resolution scattered polar responses from a flat panel, we demonstrated that diffusely scattered sound is gradually directed in a specular direction when the ratio of the width of the sample to the incident wavelength is a factor of 8 or greater. In this post, we explore the potential consequences of specular reflections originating from a recording console and reflective glass surfaces. When a delayed specular reflection coherently interferes with the direct sound, the perceived sound is distorted by a phenomenon called comb filering; so named because the interference dips are regularly spaced like the teeth in a comb when plotted with a linear frequency axis. In Figure 1, we show the frequency at which scattered energy is reflected in a specular direction for three panel widths of 3', 5', and 9' when the ratio of panel width to incident wavelength is a factor of 8 or greater.

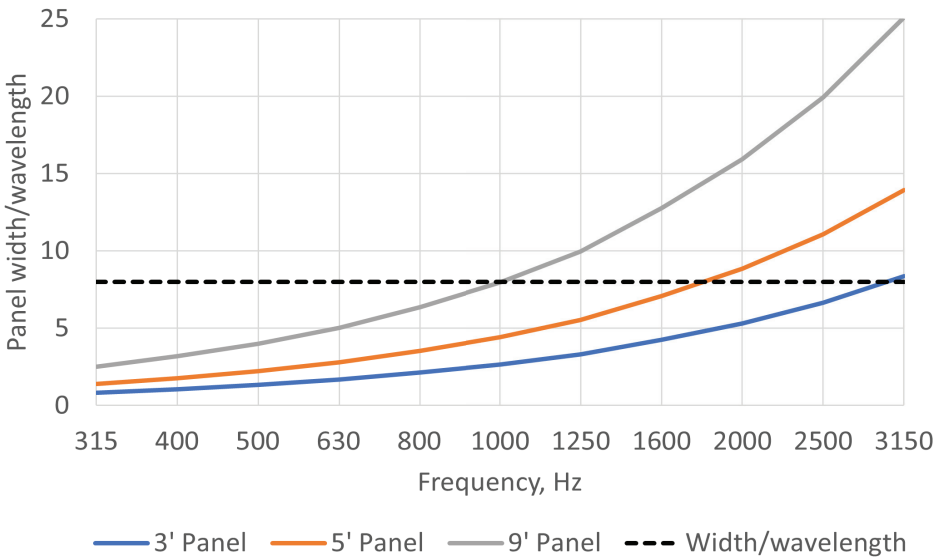

Figure 1. The onset frequencies at which specular reflections occur for a ratio of panel width to incident wavelength of 8.

In FIgure 2, we show a control room at Studio 21A in Beijing, China designed by WSDG. The control room contains two potential sources of interference caused by specular reflections, the large console situated between the flush mounted and near field loudspeakers and the mixing position, and the glass side walls, and glass window looking into the recording studio live room.

The mixing desk gives rise to console reflections at the mixing position. It is interesting to apply what we have learned about which frequencies are specularly reflected and which are uniformly diffused because this has an effect on what is perceived by the mixing engineer. If we assume that the console is 3' deep, we can see that the onset of specular reflections occurs at 3,000 Hz.

This means frequencies above 3,000 Hz will be specularly reflected and frequencies below 3,000 Hz will be diffusely scattered. One can adjust the height of the loudspeakers to change the angle of incidence and reflect from different areas on the console to attempt to mitigate the problem, but

these reflections cannot be eliminated. It helps somewhat that the surface of the console is rather irregular, due to all of the control knobs and faders. The console reflections are also problematic for free standing mid-field and near-field speakers mounted on the meter bridge.

Figure 2. Studio 21A in Beijing, China.

The glass side walls and front window, providing visibility to the live room, also create potential interfering reflections at the mix position. Typically, since the glass cannot be covered with absorptive treatment, it is typically tilted to reflect sound upward, covered with a drawn curtain during a final mix or splayed or located so that interfering reflections are directed toward the rear of the room away from the mix position. If the glass is 5' high, frequencies from 1,800 Hz and above are redirected. Below that, the sound is scattered diffusely. For a 9' glass panel, the onset frequency is 1,000 Hz.

In the next post, we will discuss comb filtering interference.

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