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## Tech Topic: Coherence & Reverberation

Real-world observations on separating the signal from the noise.

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By Merlijn van Veen (/author/merlijn-van-veen/) • January 11, 2019

Coherence is a common feature found on many analyzers that enables us to distinguish signal from noise. It will indicate whether you're measuring a loudspeaker or, for example, a moving light.



Coherence is subject to change. One of the aspects involved, among others, that we'll explore in-depth is the relationship between the direct sound of a loudspeaker in a room and the room's reverberation. This is an attempt at putting real-world observations into context. Many of the results have been obtained experimentally, and some concepts that don't directly further our understanding have been deliberately omitted.

Loosely defined, coherence is a function that indicates contamination of the measurement data. It's proportional to the ratio of signal to the sum of signal plus noise. Here's the relationship:

$$Coherence \propto \frac{S}{S + N}$$

In other words, coherence is an indicator for the signal-to-noise ratio (SNR) spectra in **Figure 1**, and by extension, speech intelligibility and related. In practice, it suffices to think of coherence as a data quality indicator. High-coherence data is reliable and actionable, informing us how to move forward with tuning a sound system. However, all of this is based on the assumption there's actual signal left over...

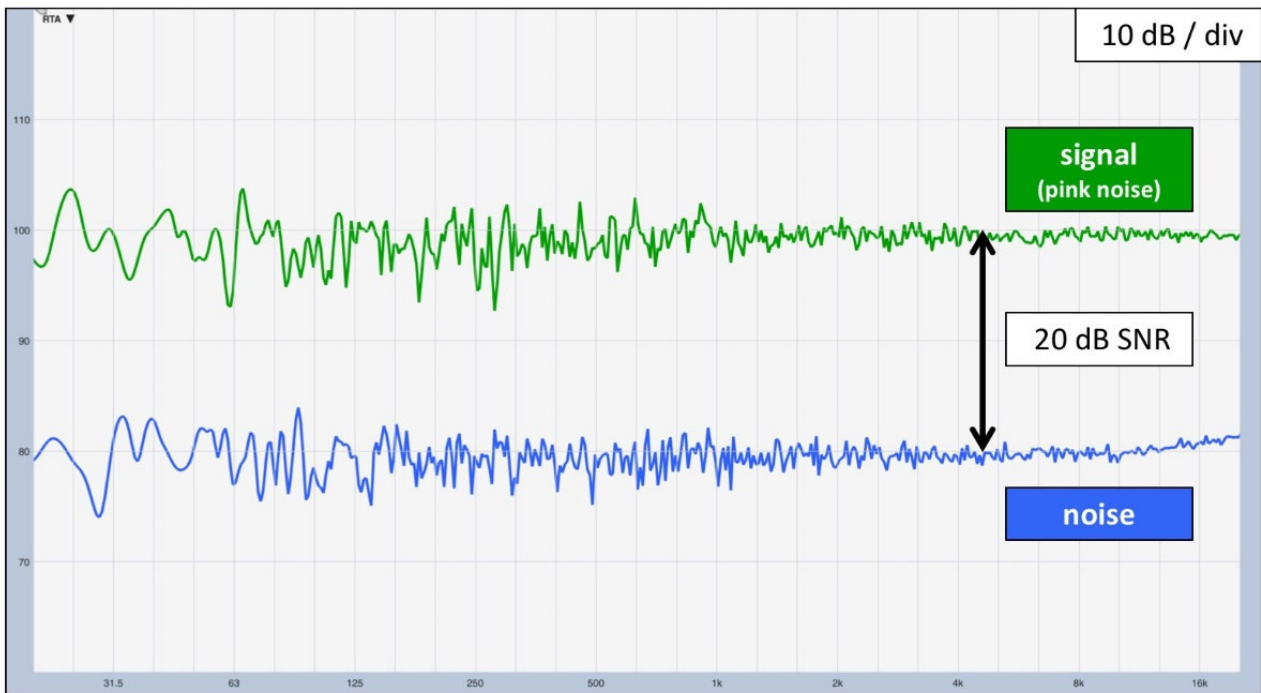


Figure 1: Signal-to-noise ratio (SNR) spectrum view.

## Destructive Interference

Destructive interference will destroy signal, which in turn will be replaced by whatever is left over. Typically, residual noises like HVAC, moving lights, generators, audience enthusiasm and the like. The spectrum of a comb filter is shown in **Figure 2**.

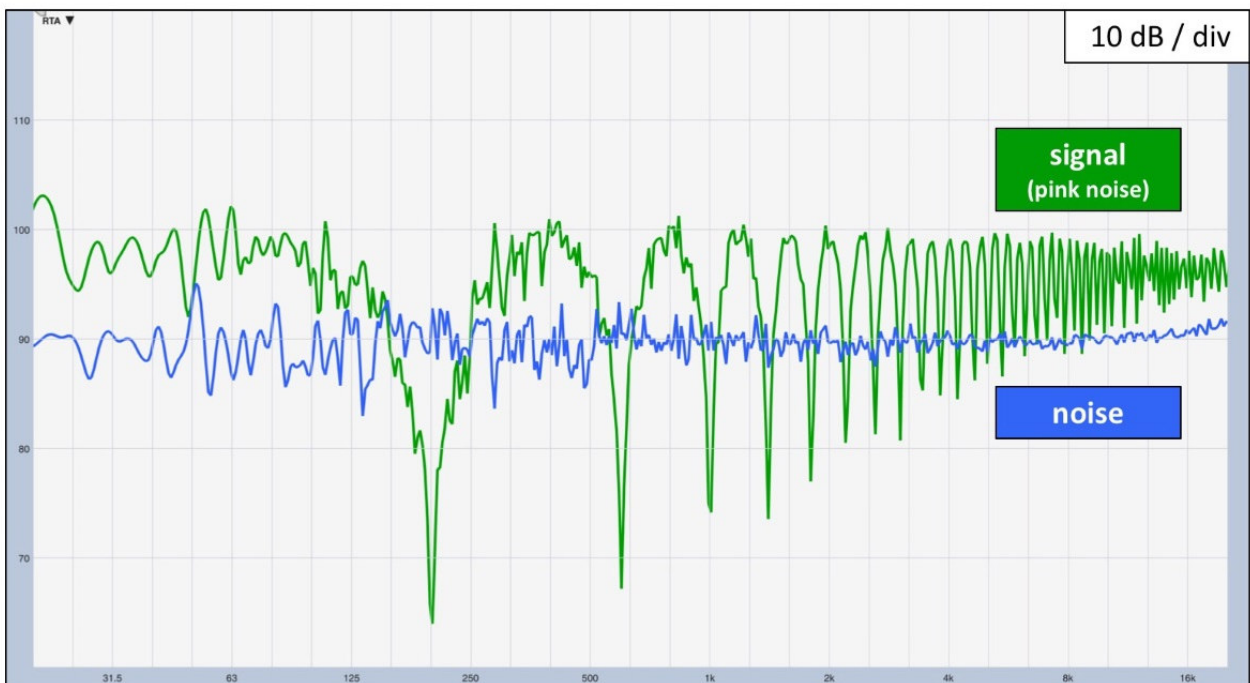


Figure 2: SNR and destructive interference.

Comb filters manifest themselves as an alternating pattern of peaks and nulls in the frequency response. They're caused by adding multiple copies of the same signal (produced by other speakers or reflections), arriving at different times, together.

Comb filters are inevitable whenever there's physical displacement between multiple sources reproducing the same signal and/or surroundings made of specular, reflective boundaries. These phenomena are particularly noticeable when walking the room while listening to pink noise and are typically described as phasing, flanging or chorusing.

Sound familiar?

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## About Merlijn

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Based in The Netherlands, Merlijn van Veen ([www.merlijnvanveen.nl](http://www.merlijnvanveen.nl)) is a noted audio educator, and he also serves as senior technical support and education specialist for Meyer Sound.

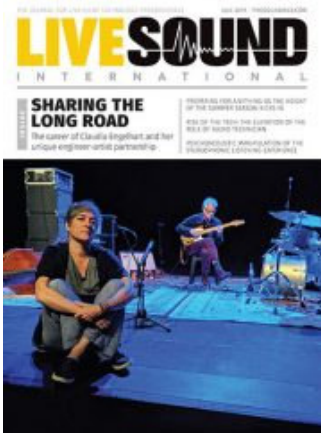
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