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Lab Notes

NCAC
National Council of Acoustical Consultants
Member

Electroacoustics & Audio

- *Consulting*
- *Design / Testing*
- *Training*

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Inside this issue:

Training Services

CJS Labs offers customized in-house training. Our design experience, proven processes, and measurement expertise will make your product development more efficient. Learn how to optimize both your designs and test routines. Having a thorough understanding of fundamentals, correct terminology, and proper techniques will also enable you to make more informed decisions and communicate more effectively with your customers and vendors as well as within your own organization. Understand why certain failure modes are problematic, even if they are not obvious or audible. Sample course outlines and details are available on our website:

http://www.cjs-labs.com/training_seminars.html

Contact us to schedule a training course for your organization.

Virtual Meetings of IEC TC 29—Electroacoustics

As a consequence of travel restrictions due to the COVID-19 pandemic, the meetings of IEC TC-29 in Warsaw in March were cancelled. Virtual on-line meetings took place 23-27 March 2020. Fifty-three delegates from fifteen countries took part in the meetings. I was head of the US Delegation and participating in 4 working group meetings: WG24 on Modular Instrumentation; WG5 on Measurement Microphones; WG13 on Hearing Aids; and WG21 on Ear simulators.

I was also named IEC TC-29 liaison officer to IEC TC-100 "Audio, video and multimedia systems and equipment", for IEC/TC-100/TA20, "Analogue and digital audio", the other IEC committee on which I serve.

Work continues on a first draft standard for modular instrumentation, a 0.4 cm^3 coupler standard, and on aligning the sound level meter, calibrator, and measurement microphone standards.

Revision of IEC 60263

The revision of IEC 60263, "Scales and Sizes for Plotting Frequency Characteristics and Polar Diagrams" which I led as convenor of MT-25, was completed and approved in March. Publication is expected later this year. For anyone working with Matlab, we have created an m-file function that ensures graphs conform to the required aspect ratios which is available upon request. Contact us for details.

News and Upcoming Events

ASA Chicago Meeting Postponed to December

The ASA Spring 2020 meeting has been postponed to 8-12 December 2020 due the COVID-19 pandemic.

https://acousticalsociety.org/asa-meetings/

ASA Standards Meetings

Due to the aforementioned postponement of the Spring 2020 ASA Meeting, the spring meetings of ASACOS and the Accredited S-Committees will take place online 12-13 May 2020.

ISO TC 43 Acoustics: Virtual Meeting June 2020

The meetings of ISO TC-43 Acoustics and its subcommittees SC1 Noise, SC2 Building Acoustics, and SC3 Underwater Acoustics in Paris this June have been cancelled due to the COVID-19 pandemic.

These standards committees will hold virtual Plenary meetings the week of 8-12 June. Virtual online working group meetings will take place on an *ad hoc* basis.

https://www.iso.org/committee/48458.html#meetings

Please contact us and let us know how we can be of service to you and your organization.

Christopher J. Struck

CEO & Chief Scientist

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CJS Labs is a consulting firm based in San Francisco, CA. We specialize in audio and electroacoustics applications. With over 30 years of industry experience in engineering and technology management, our areas of expertise include transducers, acoustics, system design, instrumentation, measurement and analysis techniques, hearing science, speech intelligibility, telephonometry, and perceptual coding. We also offer project management, technology strategy, patent & IP evaluation, and training services

Back issues of Lab Notes are available on our website at:

http://www.cjs-labs.com/lab_notes_links.html

Group Delay & Impulse Response

Group Delay is defined as the negative derivative (or slope) of the unwrapped phase response vs. frequency. It is a measure of the relative delay at different frequencies from the input to the output in a system. Group Delay, by definition, represents the relative delay vs. frequency, with any processing, propagation, or other "all-pass" delay (sometimes referred to as "excess phase") removed from the calculation -- i.e., only the frequency dependent delay corresponding to magnitude and phase variations in the frequency response.

$$\tau_{GroupDelay} = \frac{-d\phi}{df \cdot 360°}$$

The measured phase of a 2-way closed box loudspeaker system is shown in Fig. 1. The propagation delay to the measurement microphone has been removed from the data. The corresponding Group Delay appears in Fig. 2.

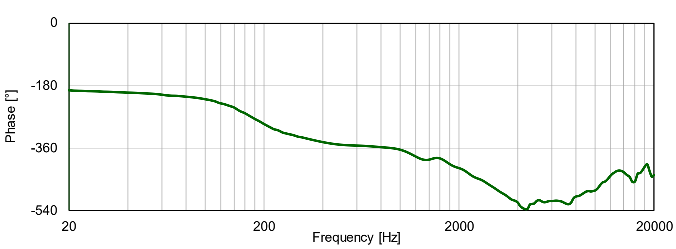

Fig. 1 Phase response of a 2-way closed box loudspeaker.

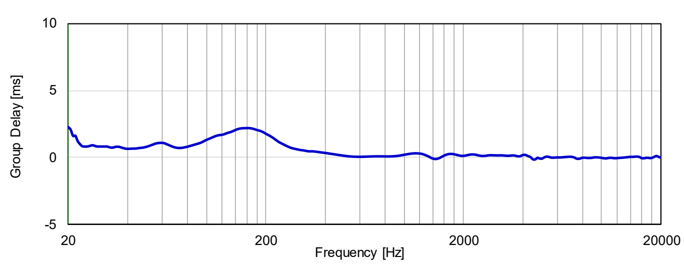

Fig. 2 Group Delay of a 2-way closed box loudspeaker.

The only requirement is that the response be sufficiently sampled in frequency so that the phase shift is never more than 180° between adjacent points. This is a necessary condition in order that it is possible to properly unwrap the phase.

Alternatively, the magnitude of the impulse response also reveals the delay in a system directly in the time domain. In a bandpass, or band-limited system, the peak in the impulse response magnitude generally represents the average group delay in the pass-band. However, if the "all-pass" propagation delay of a system is not removed from the calculation, the Group Delay (or Impulse Response) will indicate the propagation delay through the system *plus* the frequency response dependent phase derivative.

Fig. 3 shows the Impulse Response magnitude for the same 2-way loudspeaker system prior to the removal of the all-pass delay. Note that the 2.92 ms delay reveals that the measurement microphone is 1m from the loudspeaker.

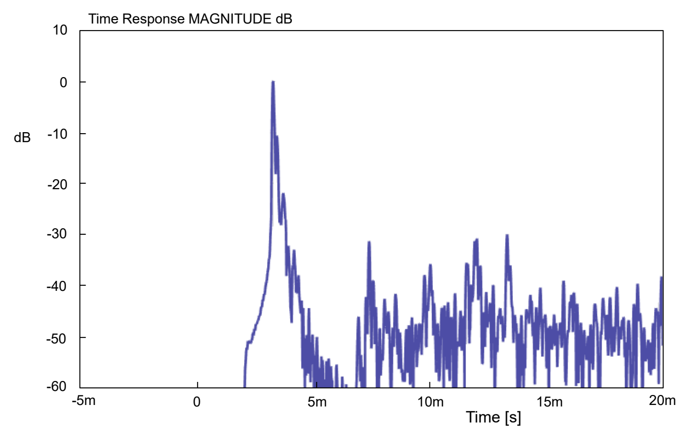

Fig. 3 Impulse response magnitude of a 2-way closed box loudspeaker showing direct sound and reflections.

Recall that the impulse response magnitude is calculated using the Hilbert Transform in order to obtain the analytic signal (time signal, real and imaginary parts). This enables calculation of a magnitude that can be plotted on a log scale with increased detail and dynamic range.

Please contact us for more information.