CJS Labs

Technology · Research · Strategy · Solutions

Lab Notes

Electroacoustics & Audio

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

Volume 10, Issue 2 **June 2017**

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.

Europe Headphone Seminars

CJS Labs followed up its successful US West Coast headphone seminars with G.R.A.S. and Listen with seminars in the U.K., Denmark and Germany in May. These events were well attended. I had the opportunity to meet many persons interested in headphone design, manufacturing and testing. My presentation focused on test methods, target response, and applicable standards. The Q&A sessions generated some interesting queries and provided useful feedback.

News and Recent Developments

IEC & ISO Standards

I was Head of the US Delegation to IEC TC-29 Electroacoustics at the meeting in Milano, Italy in March. I participated in the Ear Simulator, Hearing Aids, and Microphones working groups. I also participated in the ISO TC-43 meetings in May in Copenhagen.

AES in Berlin

I attended the AES 142nd Convention in Berlin in May. I attended a number of interesting sessions and met with clients and other persons in the industry. I also gave a tutorial lecture on headphone measurements: http://www.aes.org/events/142/tutorials/?ID=5400

Joint ASA/EAA Meeting in Boston

I will be at the joint meeting of the Acoustical Society of America and the European Acoustical Association in Boston 25-29 June. ASA Standards meetings will take place Sunday and Monday.

http://acousticalsociety.org/content/acoustics-17-boston#

Let us know if you plan to attend and would like to set up a meeting to discuss your project.

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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NCAC National Council of Acoustical Consultants Member

IEEE CNSV

CJS Labs is a consulting firm based in San Francisco, CA. We specialize in audio and electroacoustics applications. With 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

Averaging Time, Measurement Uncertainty, and Confidence Limits — Part 2

Lab Notes Vol. 8, Issue 2 discussed averaging time and confidence limits. Recall that the standard deviation for a measurement of Gaussian noise is

$$\sigma = \frac{1}{2\sqrt{BT_A}}$$

where B is the bandwidth, T is the averaging time and $BT >> 1$. A Coverage Factor of $k = 1$ is equivalent to an uncertainty of $P(L) = 68\%$; for $k = 2$, $P(L) = 95.4\%$; and for $k = 3$, $P(L) = 99.7\%$.

For a measurement in 1/3 octave bands, bandwidth is related to the filter center frequency as

$$B = 0.2307675 f_C$$

The uncertainty [in dB] in terms of Bandwidth, Averaging Time and Coverage Factor is given by

$$L_\sigma = 20\log_{10}\left(1 \pm \frac{k}{2\sqrt{BT}}\right)$$

Fig. 1 shows the uncertainty for a measurement of noise in 1/3 octave bands for $k = 2$, for various averaging times.

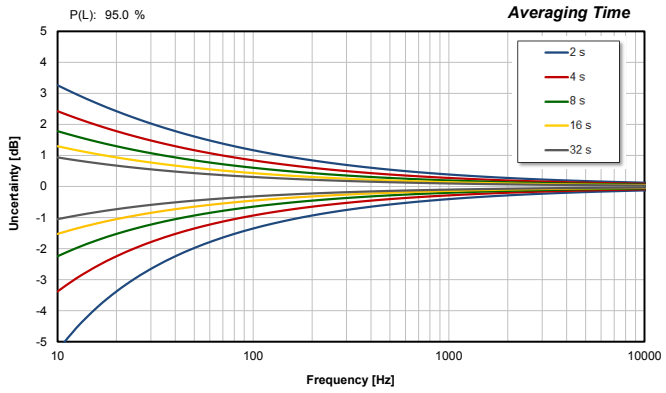

Fig. 1. Uncertainty for noise in 1/3 octave bands.

Note that the uncertainty interval is symmetric about the mean value, however, the interval is logarithmically stretched when converted to dB. The minimum averaging time for a given coverage factor and confidence interval is given by

$$T_{MIN} = \frac{1}{B\left(\frac{2\left(10^{\frac{L_\sigma}{20}} - 1\right)}{k}\right)^2}$$

This is plotted in Fig. 2 for a measurement of noise in 1/3 octave bands, with $P(L) = 95$ %, and a confidence interval of ± 1 dB.

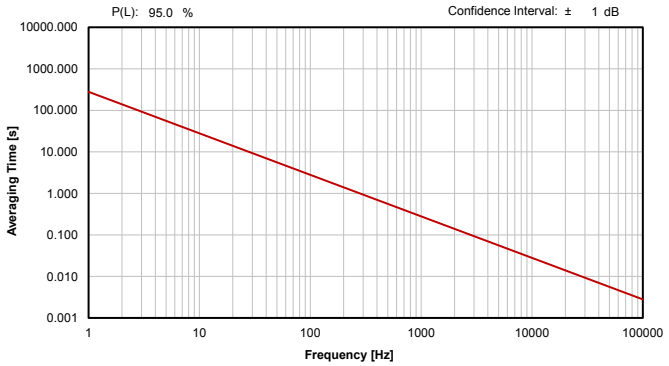

Fig. 2. Uncertainty for noise in 1/3 octave bands.

As expected, the required averaging time increases for measurements at lower frequencies, where the bandwidth is narrower.

Please contact us for more information.