CJS Labs

Technology · Research · Strategy · Solutions

Lab Notes

Electroacoustics & Audio

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

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Inside this issue:

West Coast Headphone Seminars	1
IEC TC-29 Milano, Italy	1
ISO TC-43 Copenhagen	1
AES in Berlin	1
ASA/EAA Meeting in Boston	1
Custom In-House Training Services	1
Sample Rate Conversion	2

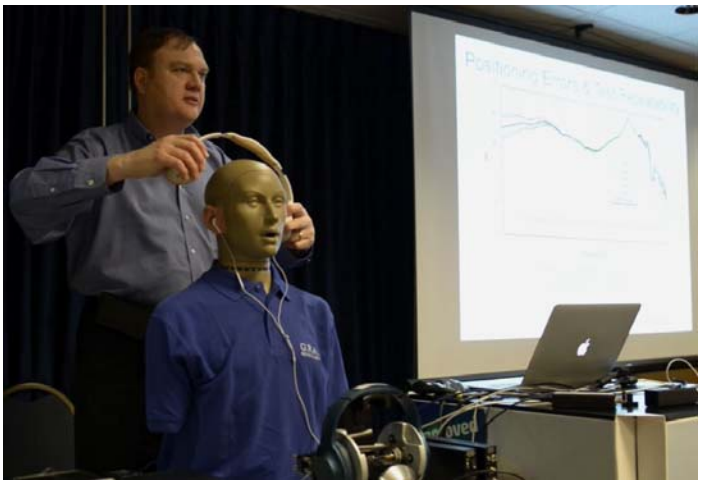
Training Services

CJS Labs also 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.

West Coast Headphone Seminars

In late February and early March, CJS Labs participated in a series of free seminars with G.R.A.S. and Listen demonstrating electroacoustic test methods and instrumentation for headphones and headsets. The seminars in Seattle, WA, Santa Clara, CA and Glendale, CA were well attended. Listen and G.R.A.S. products were featured while I described the details of various standards and test methods. Attendees were encouraged to bring their own devices to be measured. Quite a number of interesting topics came up in the Q&A sessions. I was also fortunate to meet face-to-face with many of the attendees.



News and Recent Developments

IEC TC-29 – Milano

I will be in Milano, Italy 27-31 March as Head of the US Delegation to IEC TC-29 Electroacoustics.

ISO TC-43 – Copenhagen

ISO TC-43 Acoustics meets 15-19 May in Copenhagen, Denmark. I will be there to participate in several working group meetings.

AES in Berlin

The AES 142nd Convention will take place 20-23 May in Berlin.
http://www.aes.org/events/142/

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 any of these events and would like to set up a meeting to discuss your projects.

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

Sample Rate Conversion

Digital audio signals exist at many different sample rates, depending upon the application: Pro audio uses 48 kHz, 88.2 kHz, 96 kHz, 176.4 kHz and 192 kHz; Consumer audio uses 44.1 kHz; streaming audio and voice band communication systems use lower sample rates. In order to interconnect digital devices or to perform measurements and analyses, both the output and input audio must be at the same sample rate. Dedicated hardware and software sample rate converters are used to perform this function. Synchronous conversion uses a fixed integer ratio, L/M, between the two sample rates, e.g., to convert between 44.1 kHz and 48 kHz, L/M = 147/160.

The steps in performing sample rate conversion are shown in Fig. 1.

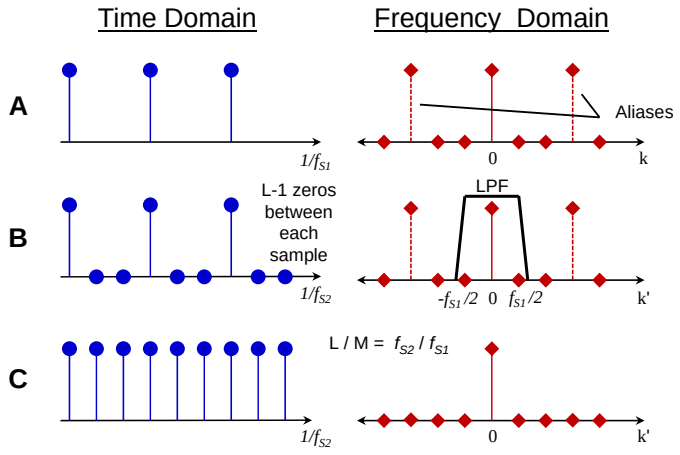

Fig. 1. Sample rate conversion process.

Fig. 1 A shows the digital signal at its original sample rate in both the time and frequency domains.

For conversion to a higher sample rate, L - 1 zeros are inserted between each of the samples of the original signal. This signal is then low pass filtered. The cut off frequency of the low pass filter is at one-half the lower sample rate (Fig. 1 B).

Every M^{th} sample from the filtered output is then selected to obtain the new signal at the higher sample rate (Fig. 1 C).

To convert from a higher sample rate to a lower sample rate, the values of L and M are simply reversed. Alternatively, sample rate conversion can be performed by interpolation, however, both methods are mathematically identical as selection of the low pass filter function is equivalent to selecting an interpolation function.

For high bandwidth, real-time applications, asynchronous sample rate converters can accept input signals with dynamically changing sample rates and output an uninterrupted signal at a different sampling rate. For most test and measurement applications, however, the stimulus signals are very short and sample rate conversion can be performed as a simple post-process operation.

Sample rate conversion is typically required when testing asynchronous digital electroacoustic devices such as USB or Bluetooth® headsets. The 16 kHz sample rate microphone output is typically converted to 44.1 kHz or 48 kHz for analysis, even though the microphone response only extends to 8 kHz. A second sample rate conversion is usually also necessary to align the actual sample rate of the device under test—which has an asynchronous master clock that may be running slightly slow or fast — to the sample rate of the analysis. This ensures frequency accuracy in the measured response.

Please contact us for more information.