



LISTEN^{INC}



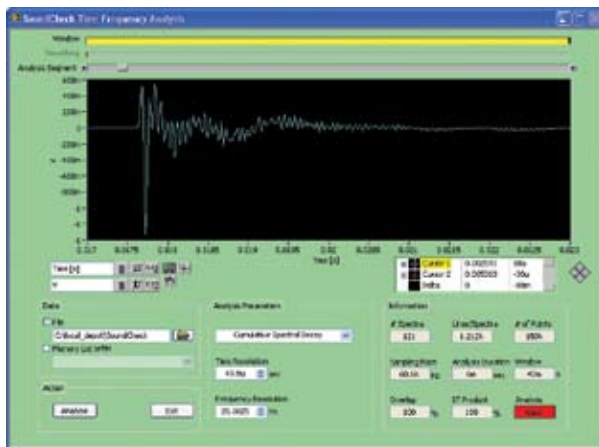
SoundMap™ Time Frequency Analysis Software

The new SoundMap™ Time Frequency Analysis software from Listen, Inc. is a stand-alone program which enables detailed analysis of signals simultaneously in both the time and frequency domain. This off-line analysis package can read measurement data directly from Listen's SoundCheck software, or any WAV file. The Time Frequency Analysis software offers the following transforms:

- Short Time Fourier Transform (STFT)
- Cumulative Spectral Decay (CSD)
- Wigner-Ville
- Wavelet

These transforms are ideal for loose particle detection, Rub & Buzz detection and impulse response analysis of loudspeakers. They are also used for identification of transient effects such as drop out in digital devices including VoIP and Bluetooth headsets.

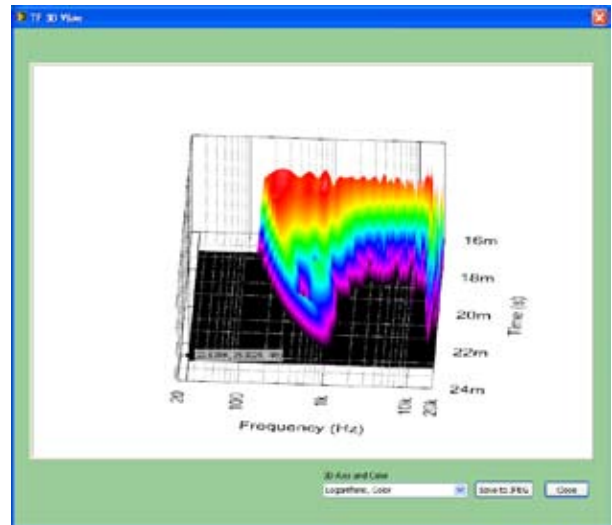
When opening SoundMap™, the initial display is a Time-Frequency Analysis window which displays the time signal to be analyzed. From this, the user can select which of the four algorithms to use, and define the analysis parameters.



Analysis window displaying time signal to be analyzed

Cumulative Spectral Decay (CSD)

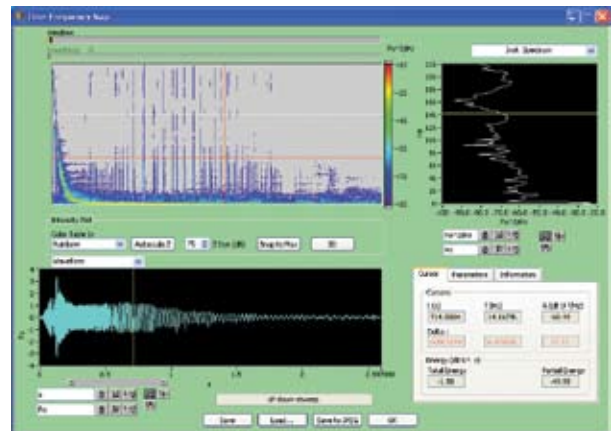
Cumulative Spectral Decay is the traditional tool for impulse response analysis of loudspeakers. It calculates the “ringing” of the loudspeaker for each frequency using the impulse response. Data can be output in a variety of formats including the widely-used three-dimensional ‘waterfall plots’.



3D Waterfall plot showing impulse response of a loudspeaker

Short Time Fourier Transform (STFT)

The Short Time Fourier Transform is a general purpose algorithm which enables observation of the spectral changes of a signal over time. This method is ideal for the detection of manufacturing defects such as loose particles and Rub & Buzz in loudspeakers, measurement of settling time and ringing in devices including loudspeakers and telephones, and analysis of dropouts, discontinuities and instabilities in digital devices.



STFT Analysis showing loose particles in a loudspeaker

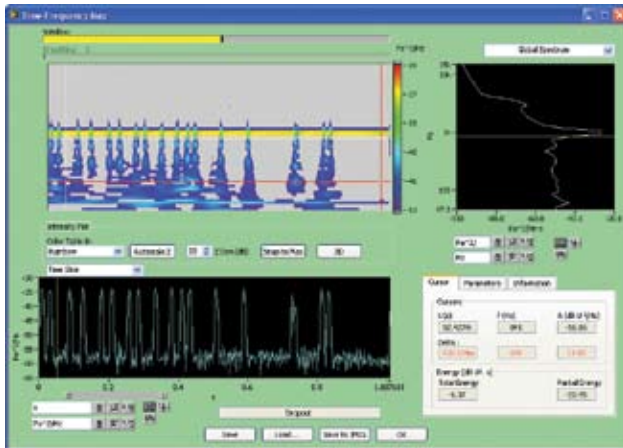


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SoundMap™ Time Frequency Analysis Software (cont.)

Wavelet

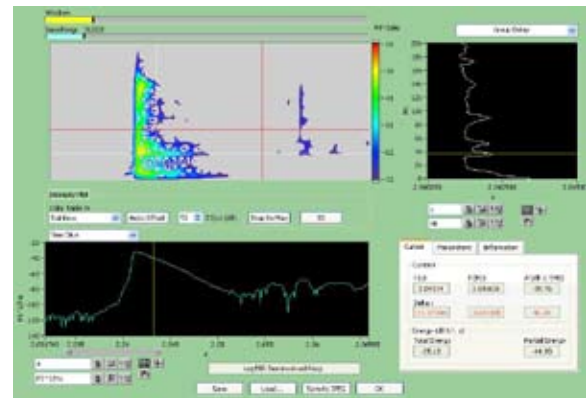
Wavelet analysis differs from CSD and STFT analysis in that it uses constant percentage bandwidth rather than constant frequency bandwidth. This offers better time resolution at high frequencies and better frequency resolution at the lower end of the spectrum. This is advantageous as it is more psychoacoustically significant and it is easy to see the entire 20Hz – 20kHz spectrum in one picture. Applications for wavelet analysis are generally the same as for STFT analysis described above; the algorithm selected depends on whether constant frequency or constant percentage bandwidth is preferred.



Wavelet analysis presented as a time-frequency map to show Bluetooth dropout

Wigner-Ville

Wigner-Ville is the ultimate algorithm for detailed analysis of very short events, for example fine analysis of transients or in-depth observation of rapidly evolving signals. Offering an output resolution of one spectrum per sample, it is the maximum achievable precision. It complements the more commonly used analysis methods discussed above.



Wigner-Ville analysis of the Impulse response of a loudspeaker showing a time-slice at 3.69 kHz and the group-delay curve.

Output Options

SoundMap™ offers a variety of display options including:

- 3D waterfall plot
- Intensity map with time and frequency slices
- Global Energy Spectrum
- Instantaneous spectrum
- Partial Average Spectrum
- Group delay
- Time envelope
- Partial time envelope
- Frequency time curve
- Instantaneous frequency