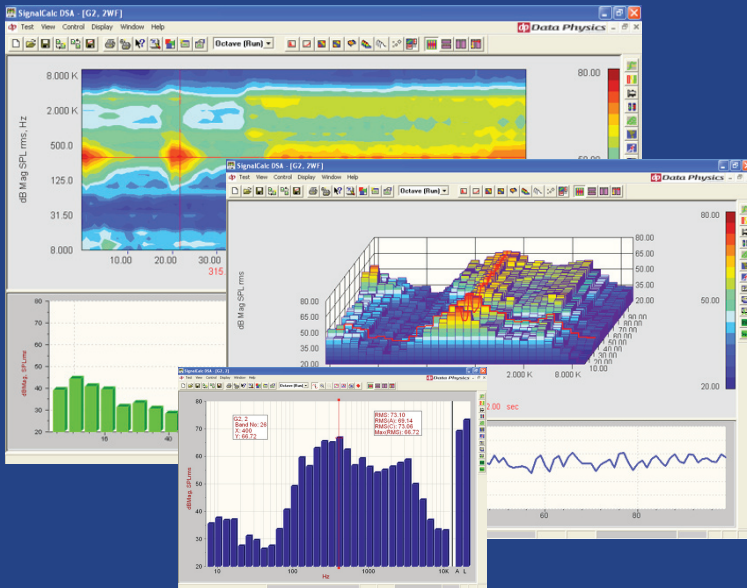**dp** Powerful Software Applications

Acoustics

Engineered for SignalCalc Dynamic Analyzers

- ACE
- Mobilyzer
- Savant

Acoustics

Octave and fractional octave bands have been used for several decades now in the characterization of acoustic energy in various applications. Early analyzers were essentially comprised of analog filter banks. Band filtered data resulted in fewer numbers, making data easier to pass around before the advent of powerful PC-based systems that we are accustomed to today. Standards developed for acoustic applications were therefore based on filtered data, and this has largely resulted in the need for continued analysis using true filtered octave and fractional octave analysis. Practically speaking, however, the human response to noise and vibration is very non-linear in nature and most mechanical systems have a behavior that is best characterized by proportional bandwidth analysis.

Realtime Octave Analysis

The SignalCalc Realtime Octave Analysis option provides realtime octave band, 1/3 octave, 1/6 octave, 1/12 octave, and 1/24 octave band spectral analysis. The analysis is implemented by digital filter banks that conform to ANSI S1.11 – 1986 specifications in all regards.

Advanced and Flexible Signal Processing

In order to cover every possible test application, three modes of analysis are provided: Realtime DSP computation where a large number of channels must be analyzed simultaneously, realtime HOST computer computation where extended frequency coverage is required, and playback analysis of throughput-to-disk recordings, providing both extended frequency coverage and the advantage of applying multiple analysis types and setups to exactly the same measurements.

DSP analysis is always made in realtime regardless of the number of channels employed. However, the number of active channels affects the frequency range of analysis available. Host analysis extends (Type 1, Class D) octave and fractional octave band

analysis to any span from 1 Hz (Band 0) to whatever upper limit is enforced by the sampling rate of the analyzer. Superior timing is also provided by this mode; repetitive linear averaging may be performed without missing any data between successive integration intervals. Host mode also provides user control over the settling time of the filters, useful when transient sounds are encountered.

Playback Analysis applies Host mode processing to previously recorded signals. The recording may be made during a Realtime Octave analysis or any other test type. This permits integrating octave and 1/3 octave analysis with other analytic procedures on the same measured data.

Comprehensive Setup Options

Fast" or "Slow" detector time constants, in accordance with IEC 651, are provided, and desired exponential time constant between 8 ms and 16 s are also available. Spectral values can be updated and passed to waterfalls at a separately specified rate that may be as brief as 2 ms. Alternatively, linear integration may be selected, with integration times as short as 2 ms or as long as 10,000 seconds. Inputs may come from a "flat" microphone, from a sound-level meter or other spectrally weighted source.

The **Channel Input** control permits identifying any external weighting (A, B or C), so that it may be compensated for when choosing display amplitude scaling.

In order to retain peak amplitude information, a Max Hold option is available, or the Min Hold option can be used to analyze background noise levels. SignalCalc automatically calculates and sets a filter settling time that is based on the low frequency limit you've selected for your range, thereby guaranteeing the validity of your low frequency data when analysis starts. However, the filter settling time may be specified to be different from the recommended by the user.

## Synthesized vs. Realtime Band Filtered Octaves

The standard Auto Power Spectrum software package in SignalCalc analyzers allows the display of a synthesized full octave or 1/3 octave spectrum. This display uses FFT data, averaged and weighted to approximate the filtering used in classical octave analysis. While this method can be adequate for measuring time invariant signals, it is not sufficient for dynamic signals, and does not provide results that conform regulatory requirements. The Realtime Octave Analysis option goes far beyond this capability, ensuring that the signal is processed through a set of digital filters that are implemented to meet the specifications of ANSI S1.11 – 1986, thus allowing measurements that will meet the needs of regulatory compliance. You can also create and specify a custom input filter for each channel, if needed.

Powerful Display Capabilities

Octave spectrum graphs, 3-d color spectrograms and waterfalls along with related records and slices make the presentation and analysis of acoustic data extremely straightforward. Realtime Octave measurements have the hallmark ease of accessibility that many have come to expect from the SignalCalc family and the enjoy the same flexible layout control, data format conversion, test review, data streaming and reanalysis that are integral to SignalCalc analyzers.

In addition to the 1/3 octave levels, Octave spectrum graphs have a bar graph representing the continuous A weighted loudness, as well as the overall unweighted rms level. Powerful statistics features allow values to be displayed directly on the graphs. For 1/3 octave values with a specific weighting applied, a convenient units tab allows users to choose the desired weighting for the display. In addition to viewing the octave bar graphs, it is possible to display a graph of the SPL values versus time. When averaging is set to linear, the A weighted loudness graph represents Leq, or equivalent level, versus time, at the selected integration time.

If fractional octave analysis across narrower frequency bands than 1/3 octave is required, the data can be streamed to disk using the Throughput-to-Disk option, and then be played back for reanalysis. Without the requirement to keep up with a realtime signal, accurate fractional octave analysis becomes possible.
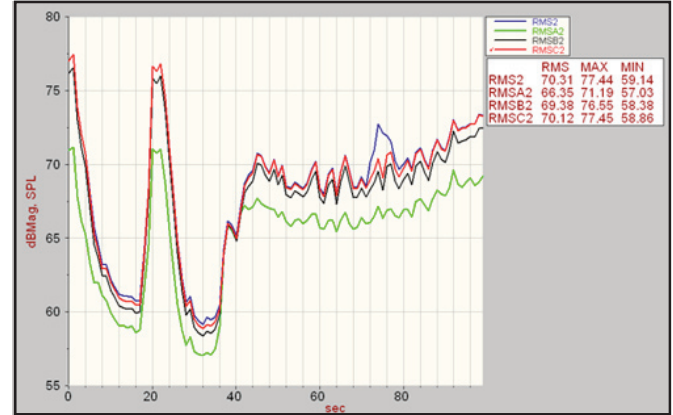
Applying to Metrics to Sound Quality

Human beings seem to hear roughly in proportional bandwidth at higher (>500Hz) frequencies, and at fixed bandwidth at lower frequencies. Human ears act as though they have filter banks in them; if a loud sound is going on at one frequency, it will mask sounds at nearby frequencies. The effect is as though the filter is already occupied. Furthermore, different people respond in different ways and different products have different preferred sounds. What sounds good in a sewing machine is not what you would want your automobile to sound like.

For further characterization of the noise, a Sound Quality package is available. Based on jury trials and the Zwicker body of research, this package measures many characteristics which correlate to human response. **Loudness** attempts to determine what a person means by 'loud', accounting for nonlinearities and masking. **Sharpness** measures a parameter similar to loudness, but with a high-frequency penalty. **Fluctuation Strength** characterizes low frequency amplitude modulation. **Roughness** addresses higher frequency modulation, for example a "buzzing" sound. Finally, **Annoyance**, which is a combination of loudness, sharpness, fluctuation strength and roughness and is unitless, attempts to provide a comprehensive measure of a person's perception of the sound being experienced.

Setup parameters for Sound Quality measurements are virtually identical to those described above for Octave band analysis. The same powerful graphics, data management and export capabilities are available, providing users with a previously unavailable tool by which a product's sound quality may be measured and enhanced.

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Discover more at www.dataphysics.com