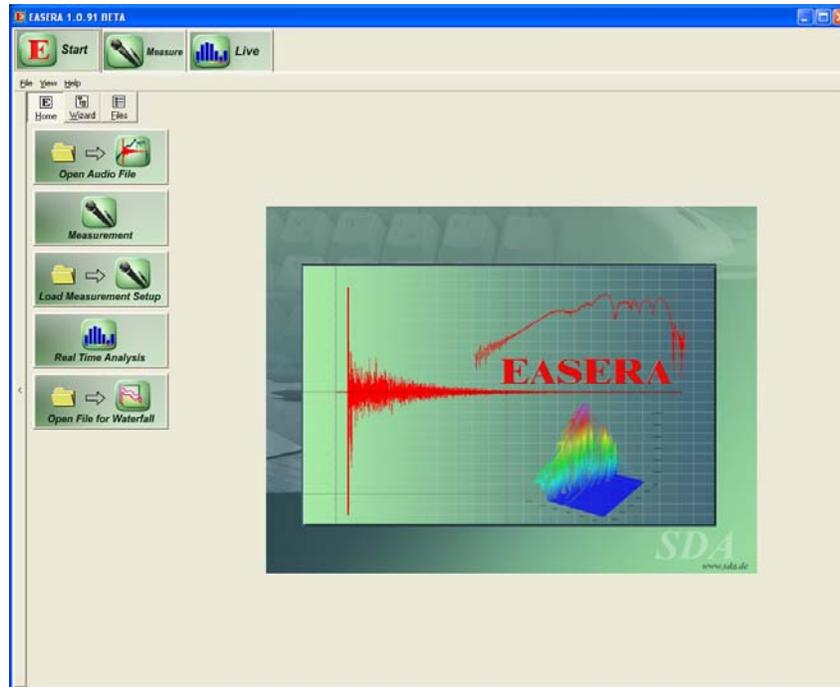


Charlie Hughes

EASERA

Electronic & Acoustic System Evaluation & Response Analysis



Introduction

EASERA (pronounced 'Ez-rä) is a relatively new, yet very powerful software based acoustical measurement system from SDA (Software Design Ahnert GmbH). These are the same folks that write the code for the EASE acoustical modeling program. EASERA runs on a Windows based PC (98, 2000 & XP) using almost any audio interface hardware / soundcard. It is capable of processing up to 32 input channels with a resolution of 32 bits and sample rate of 192 kHz. Supported audio device drivers include Windows, DirectSound, Wave and ASIO. If three or more input channels will be used ASIO drivers are required. The accuracy of a measurement made with EASERA is limited only by the hardware used.

While most soundcards will provide good results, some are limited in their use with EASERA due to latency and synchronization issues. This mainly affects the sample accurate timing of multiple hardware devices used simultaneously and input/output synchronization. The EASERA Gateway has been specifically developed so as not to suffer from I/O sync issues. It is currently the only audio hardware available that supports the use of TDS (Time Delay Spectrometry) measurements with EASERA. The

Gateway is a heavily modified version of the PreSonus Firebox. When combined with EASERA they make a solid measurement system.

The EASERA user interface, while initially somewhat overwhelming due to the density of information displayed, is well organized in a very logical manner. Operation becomes quite intuitive after diving in and doing several sets of measurements. A very comprehensive user's manual also aids in finding one's way around the software.

There are six tabs at the top of the EASERA window. Only three of these (Start, Measure and Live) are shown upon instantiating the program. Once a measurement is made or a file opened View & Calc is shown. A Results tab is also displayed when View & Calc is visible. A Waterfall tab can be made available for viewing the 3-D (frequency, magnitude and time) nature of signals. Selecting one of the tabs determines the information displayed in the rest of the window.

The real horsepower of EASERA is in its Impulse Response (IR) measurement and analysis capability. Measurements are, of course, performed from the Measure tab while analysis is performed from the View & Calc tab. A system's IR contains all possible information about how that system will respond when excited by a stimulus. Thus measuring and analyzing the IR is the most complete way to characterize a System Under Test (SUT).

Live

In addition to its ability to perform IR measurement, EASERA also has a real-time analyzer. This is accessed via the Live tab. Live displays a frequency response spectrum and a spectrograph (Figure 1). These may be set to show the input of a selected hardware channel or a transfer function. The transfer function can be very useful as it compares one channel to another and displays the difference. Any input can be selected to be monitored and any input can be selected as the reference. This provides an excellent way to examine multiple coverage zones within a venue during a performance or system tuning. Similarly, multiple fold back mixes can be input to EASERA and displayed at the click of a software button.

There are various windowing, averaging and FFT size options to optimize Live for a particular application. The display can show flat, A, B or C weightings in 1/N octaves or broadband. Peak and RMS levels can be displayed. There are multiple "slots" where curves may be stored for overlay and comparison (Figure 2). These may also be saved to a file for later use. They may be loaded directly into the display or as background or tolerance curves for comparison. Several useful sets of predefined background overlays that may be displayed are NC (Noise Criterion), PNC (Preferred Noise Criterion) and NR (Noise Rating). These all relate to standardized noise levels.

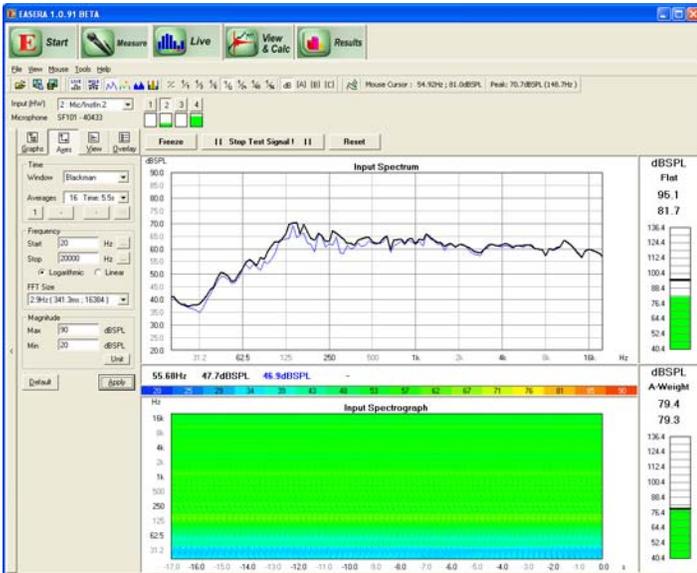


Figure 1 – Live measuring a loudspeaker

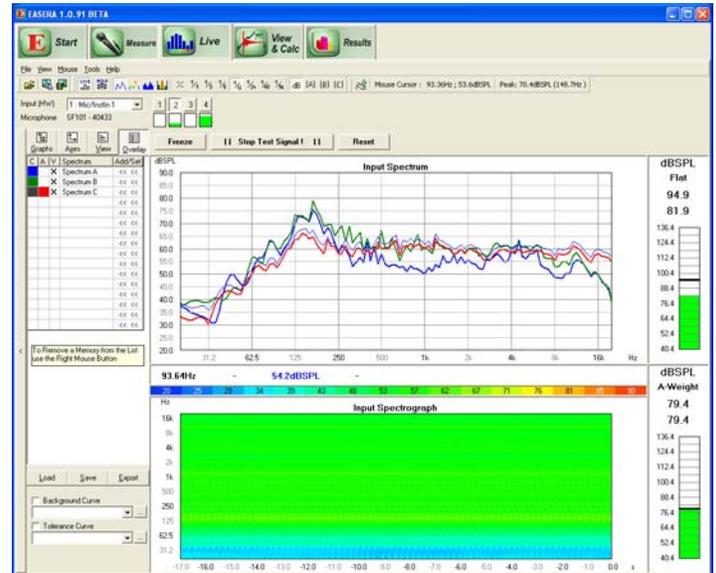


Figure 2 – Live showing overlays of stored measurements

Measure

Let's look at the Measure tab. Selecting this tab displays all of the information relevant to setting the parameters to make a measurement (Figure 3). This window is divided into four separate sections; each dealing with a different aspect of a measurement set-up.

The first is the Select Measurement Setup section (1). This allows selection of Measurement Setup (single channel, dual channel, dual channel FFT, multi-channel, multi-channel FFT, TDS, etc.), the hardware (soundcard) that will be used, what input(s) and output(s) of that hardware will be used and calibration of the hardware. If absolute levels (say SPL) are needed the microphone and soundcard must be calibrated. EASERA includes a very handy calibration routine for this. It has been much improved since the initial release.

Once the appropriate Measurement Setup selections have been made the Choose Stimulus Parameters section (2) should be examined. Stimulus type (sine wave, linear swept sine, log swept sine, MLS, white & pink noise), sample rate, measurement time and output level need to be set. Different frequency weightings are also possible via three large buttons. There are even provisions within EASERA to allow user defined stimuli.

On to section three, Adjust Levels, next. This allows a preview of the levels to be used during the measurement to make sure they are not too low or too high. Clicking on the Play Test Signal button does just that. The input level can then be monitored in the

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Channel #1 display window. If more than one input channel is necessary for a particular setup, a second input window will be displayed. Peak and RMS level text boxes as well as a signal to noise ratio (SNR) text box display these levels to aid in choosing the proper measurement level.

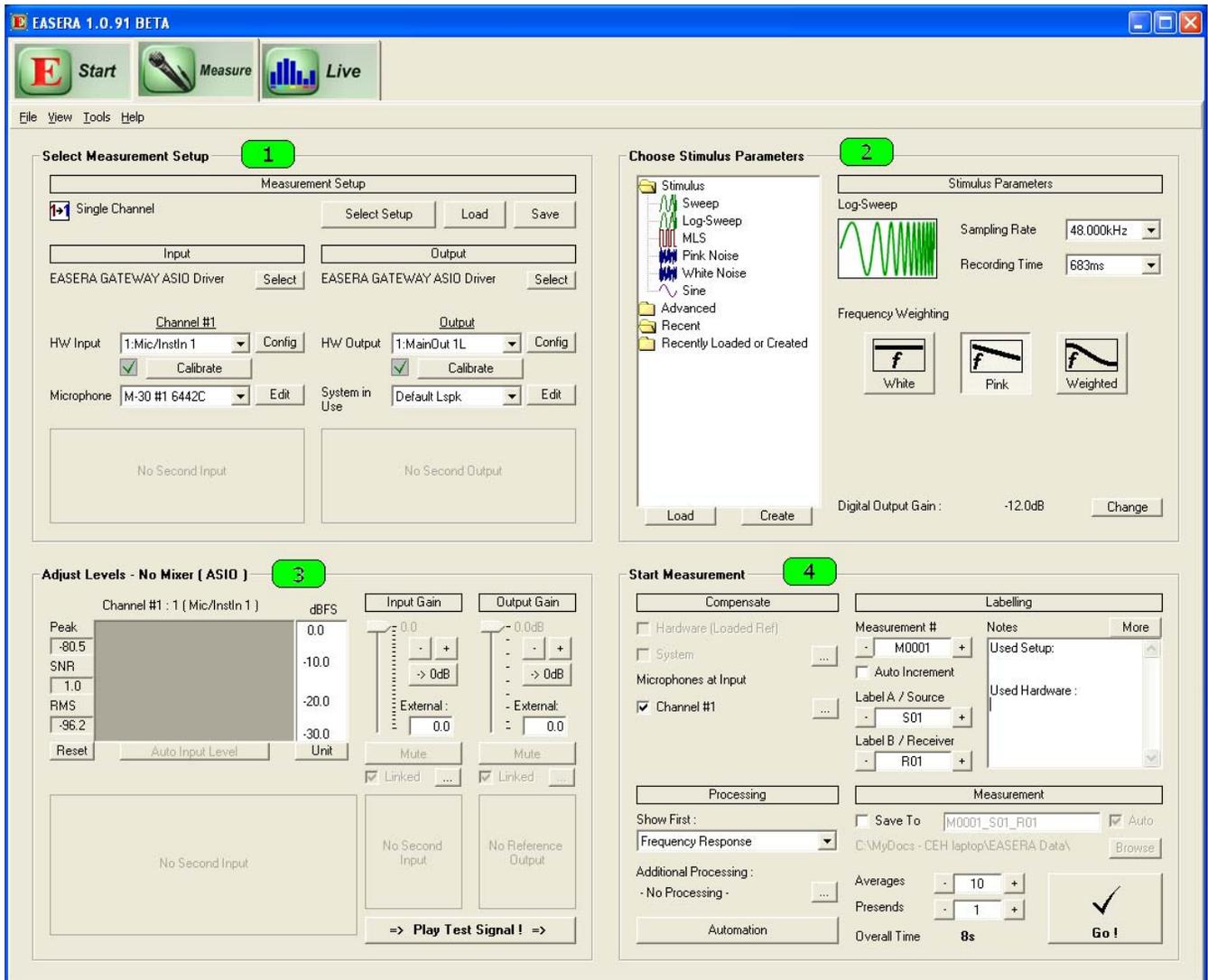
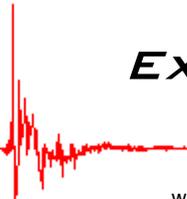


Figure 3 – Measure tab

The fourth and final section is the Start Measurement section. There are four sub-areas here; Compensate, Labeling, Processing and Measurement. The Compensate area is very interesting. It enables EASERA to compensate for less than ideal measurement hardware (soundcard), system (generally a source loudspeaker) and measurement microphone(s).



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It is a relatively straightforward process, explained in the manual, to measure a soundcard, loudspeaker or microphone using EASERA and generate a reference file that is used to compensate that particular device so that its non-flat frequency response will be removed from a measurement. This allows the use of less expensive soundcards and microphone for those on a budget while still allowing good measurements to be made.

The Labeling area is pretty self explanatory. The Measurement #, Label A / Source and Label B / Receiver text boxes can be used to describe the measurement. These can also be automatically combined to yield a file name for the measurement (in the Measurement area). If Auto Increment is checked the Measurement # will automatically increase for each measurement. This can be a real time saver when making lots of measurements. The Notes text box can hold as much descriptive info as one would like about a measurement setup, job site, conditions, etc.

The Processing area is also a very powerful part of EASERA. Show First determines how the data will be displayed immediately following the measurement. Additional Processing is where lots of neat stuff can happen. EASERA allows for many different post processing operations on measured data. This is called an Editing Sequence and will be described in more detail later. Once an Editing Sequence has been created it may be applied on-the-fly to a measurement as it is made. This can be an enormous time saver if the same processing is required on many different measurements (i.e. windowing). The Automation button brings up an Automated Measurements dialog box. This can be very useful when multiple measurements of a given type are required. It is primarily geared towards making directivity (polar) measurements. There are soon to be provisions within EASERA to communicate with various third-party turntable systems (Outline, Linear X, etc.) to completely automate this time consuming type of data acquisition.

The Measurement area is the last stop in this section. Checking the Save To box will automatically save the measurement with the file name in the adjacent text box. This can be entered manually or, if the Auto box is checked, the file name will be the concatenation of the three labels in the Labeling area as previously mentioned. The file will be saved to the location below the file name text box. This is easily changed by clicking on the Browse button. Averages allow many stimulus excitations to be made one after the other and averaged together. This can be useful for increasing the signal to noise ratio of a measurement. The Presents allow for initial excitation of the device under test (DUT) without that stimulus being included as part of the measurement. Finally we come to the Go button. This will start the measurement with all of the selected parameters.

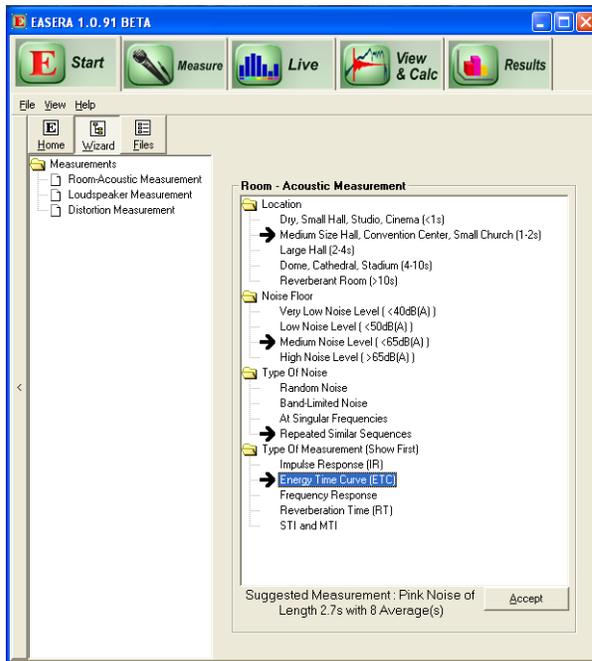


Figure 4 – Wizards selection screen

If having to select all of the parameters for a measurement seems daunting, fear not. The folks at SDA have included some Wizards that help set a lot of these parameters. By selecting the Start tab and the Wizards button several generic measurement scenarios (Room Acoustics, Loudspeaker & Distortion) are displayed in the left pane (Figure 4). Selecting one of these will display several possible options in the right pane. By selecting the options in the right pane that most closely resembles your measurement situation the wizard will suggest measurement parameters that are generally appropriate. These are displayed below the pane. Clicking on the Accept button immediately jumps to the Measurement tab with the suggested parameters loaded. Now just make sure the right hardware is selected, check the levels & hit Go to make the measurement.

View & Calc

As soon as EASERA has completed a measurement the data will be displayed in the View & Calc tab. The measured impulse response (IR) of a loudspeaker system is shown in Figure 5. The same measurement is shown in Figure 6 as the magnitude (frequency) response. By simply selecting any display type in the left pane the calculations for that display are performed and appear almost instantaneously in the right pane. Multiple measurements may be overlaid. A set of polar measurements in one plane is shown in Figure 7. Harmonic distortion spectra are also easily displayed (Figure 8).

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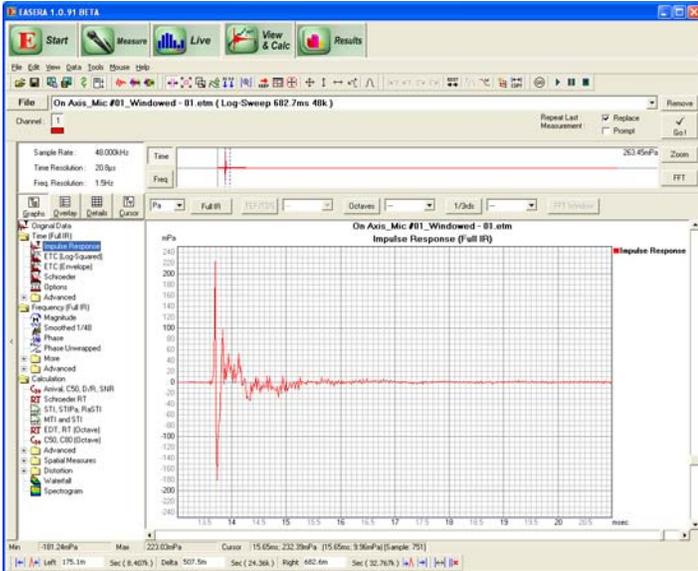


Figure 5 – Impulse response of a loudspeaker

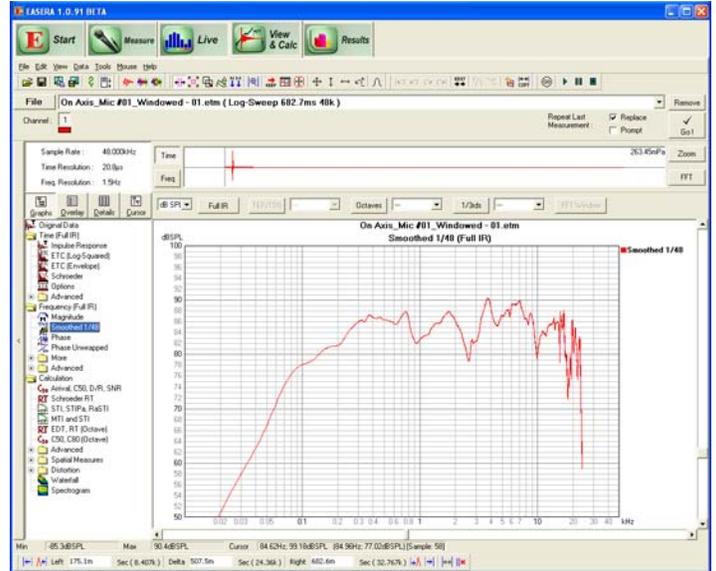


Figure 6 – Frequency response

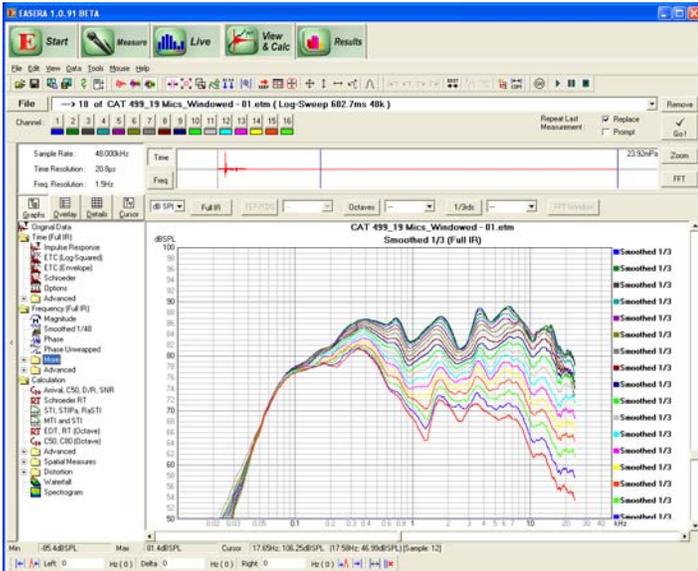


Figure 7 – Overlay of directivity (polar) frequency response curves

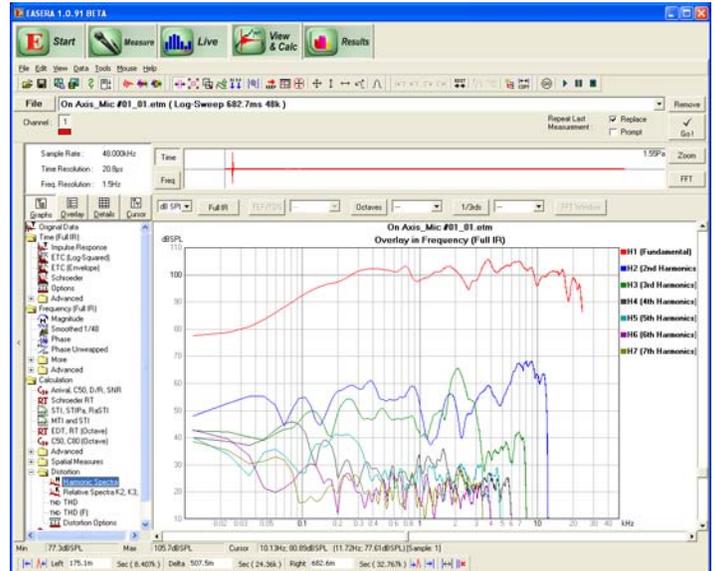


Figure 8 – Harmonic spectra

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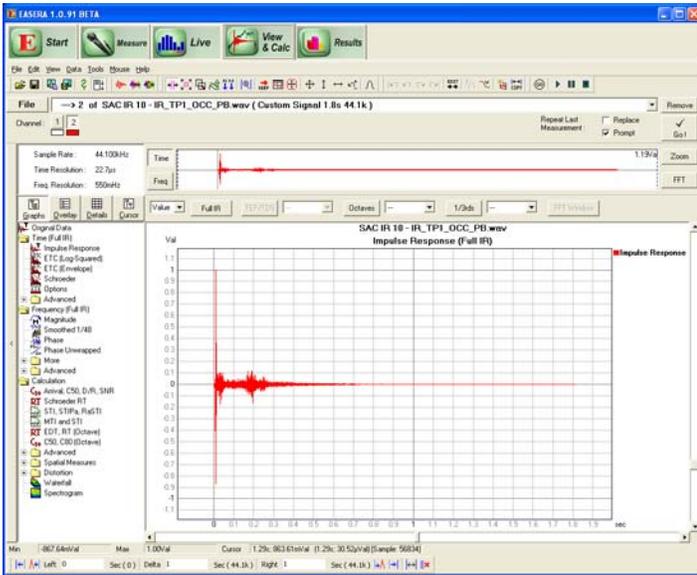


Figure 9 – Room impulse response

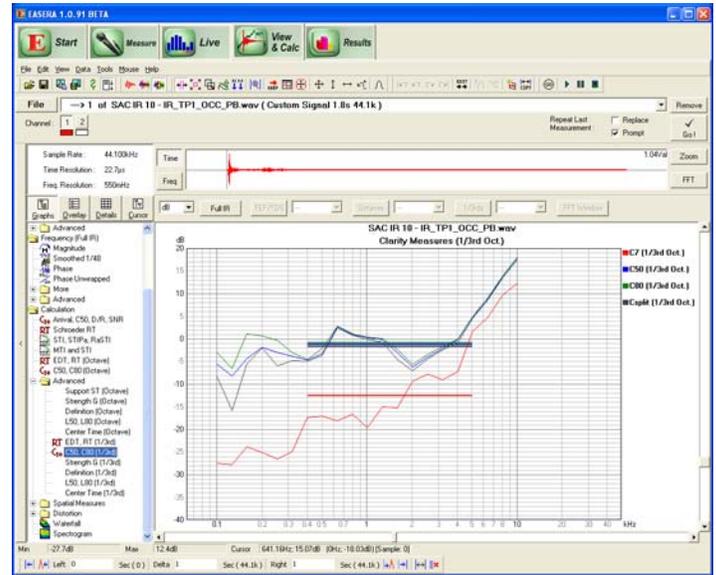


Figure 10 – Clarity metrics (C7, C50, C80 & Csplit) in 1/3 octave bands

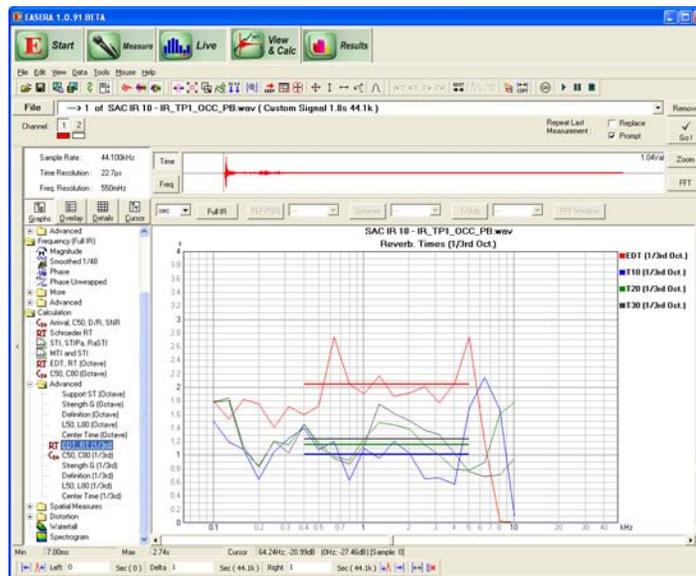


Figure 11 – Reverb Times (EDT, T10, T20 & T30) in 1/3 octave bands

Room acoustics metrics are also easily calculated and displayed after a room IR has been measured. EASERA can also open a wav file of a measured IR to calculate and display these. Examples are shown in Figure 9 - Figure 11. A listing of the possible display types is shown in Figure 12. For many of the different types of displays, clicking on the Results tab displays the data in tabular form (Figure 13). This can be very handy for copying and pasting into reports or spreadsheets for further analysis.

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Figure 12 – Selection of possible display types

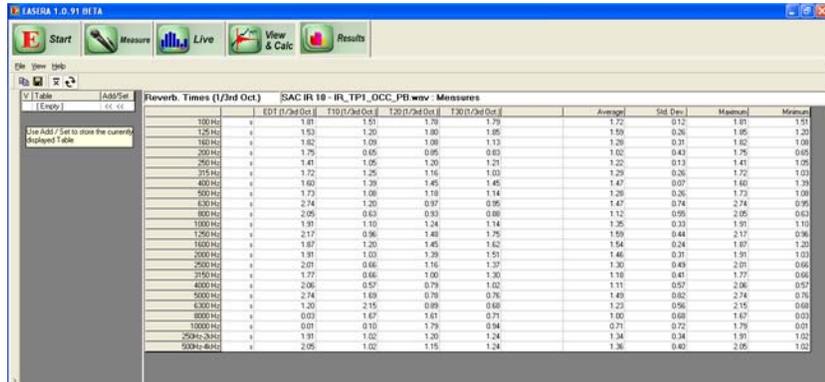
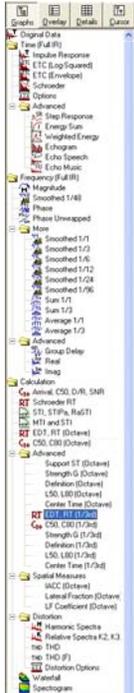


Figure 13 – Results tab of Reverb Times display from Figure 11

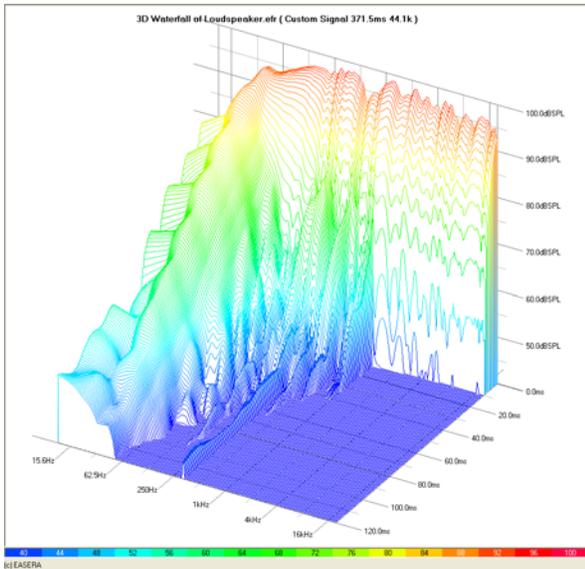


Figure 14 – Waterfall display of the IR of a loudspeaker

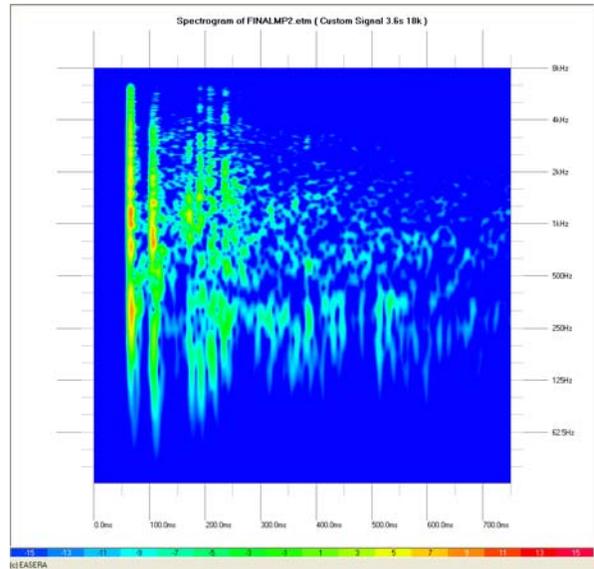


Figure 15 – Spectrogram of a room IR measurement

Selecting either the Waterfall or Spectrogram display will bring up the Waterfall tab. This tab can be used to view a signal in both the time and frequency domains simultaneously. This can be very useful for investigating the frequency dependent

resonance behavior of a loudspeaker (Figure 14). The spectrogram view can also be useful for visualizing the frequency content of reflections and/or room decay (Figure 15). There are many parameters available to optimize these displays to render the type of information desired.

Also provided is a very nice feature to directly export any displayed graph to the Windows clipboard or to a graphics file (BMP, JPG, GIF, TIF, etc.) for use elsewhere.

Editing Data (Post Processing)

Another of the areas in which EASERA excels is its ability to process data after they have been acquired. This can be done with measurements made with EASERA or with wav or other file types that it can open. Windowing (in the time domain) can help remove or minimize the effects of unwanted portions (noise, reflection, etc.) of a measurement. A measurement can be moved in time (Cyclic Move) for alignment to other measurements or to remove excess phase (propagation delay). In the frequency domain low pass, high pass and band pass filtering can be applied to remove unwanted portions of the spectrum.

There are also utilities which allow for addition, subtraction, multiplication and division. Not only can a constant value be arithmetically applied to a measurement (say for level adjustment) but two measurements may be processed with these operations. Dividing one measurement by another, in the frequency domain, allows for a good display of the difference, in dB, between the two measurements. As multiplication and division in the frequency domain are analogous to convolution and deconvolution in the time domain, two measurements may be convolved or deconvolved as desired.

All processing steps applied to data are kept in memory until the resultant curve is removed. This way the individual steps need only be performed once manually. They can then be saved as an Editing Sequence (i.e. macro) and applied to other measurements. They can be applied after the measurement is taken (post-processing) or they can be applied on-the-fly, as the measurement is being taken, as previously described in the Processing area of the Measure tab.

Conclusion

Whether one is measuring loudspeaker components, systems, microphones, electronics, acoustical treatments or room acoustics, EASERA offers a wide variety of measurement, data processing and display options. It is equally adept for use in the laboratory or in the field. It is the type of measurement system that will allow its users to learn and grow in their knowledge of measurements and acoustics. A 30-day evaluation version can be downloaded from <http://www.easera.com/>.