SonoSOFT Analysis Printed Documentation

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SonoSOFT Analysis

Welcome to SonoSOFT

Welcome to Sonometrics Analysis Software help documentation. Please select from the following:

1) Installing SonoSOFT
2) Upgrading SonoSOFT
3) Working in SonoSOFT
4) SonoConvert
5) Batch Processing
6) SonoVOL
7) View 3D
8) Appendix A: File Extension Definitions
9) Appendix B: Calculations In CardioSOFT

New Installation of SonoSOFT

New Installation of SonoSOFT

Currently all Sonometrics software will be available on CD-ROM. All delivered software will come equipped with license keys for installation. The new CD-ROM will include acquisition software and analysis software, dependant on license keys and upgrades purchased.

1) Software Installation Procedure.
2) Installation of SonoSOFT Manual.

Installation Procedure

To begin, insert *SonoSOFTTM CD* with Windows 98, NT running. The installation procedures should start automatically, if not, click *Start* followed by *Run.* Browse the CD ROM to locate *Setup.exe* file and double click.

1) When installing *SonoSOFT* , close any other programs running in Windows.
2) Please fully read the *Licensing Agreement* before selecting *Yes* button. If *License Agreement* is not accepted the installation will not proceed. Please go to Licensing Agreement for more information.
3) The Information Page will outline new features and enhancements of the software version. When finished click *Next >* button.
4) When prompted, enter the User Name and Company. This information will be saved and accessible later. Select *Next >* button.
5) The default directory for SonoSOFT is “C:\SonoSOFT\”, which is created during the installation process. To change the destination of SonoSOFT select *Browse* from the Choose Destination Location window to scroll through system folders.
6) Select purchased software packages from the software list. Please note, if user does not have corresponding license keys the software will install but will not run.
7) Enter License Keys as listed on the CD case. Note*: Key codes must be entered exactly as printed on CD case including hyphens and capitalization. Once numerical codes have been entered press Next >.
8) Software will complete installation and ask the user to shut down the computer. Newly installed software will not run properly until the computer is shut down and restarted.

Installing SonoSOFT Manual

Once SonoSOFT software installation is completed the user will be asked to install an electronic copy of this manual in Adobe Acrobat format.

1) Select Yes and Adobe Acrobat reader will install automatically with version 4.0 unless already present.
2) The Destination Installation Location menu will open and the user may select a location to save the files. Once path is selected Press *Next >* and Adobe will begin installation.
3) To access the manual, open the SonoSOFT folder and select *SonoSOFT.pdf*.

Upgrading SonoSOFT Software

Upgrading SonoSOFT Software

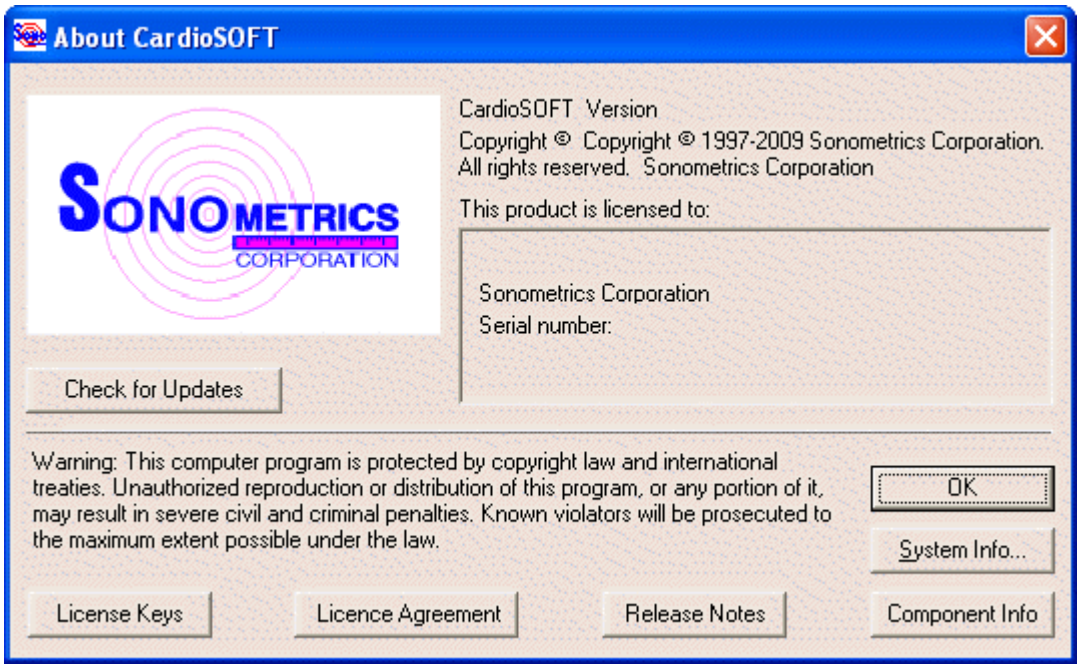
Upgrading SonoSOFT may be accomplished from CD ROM or website download. Once the Installation Shield has begun follow these steps.

Before upgrading the user must ensure the proper Licensing Keys are available.

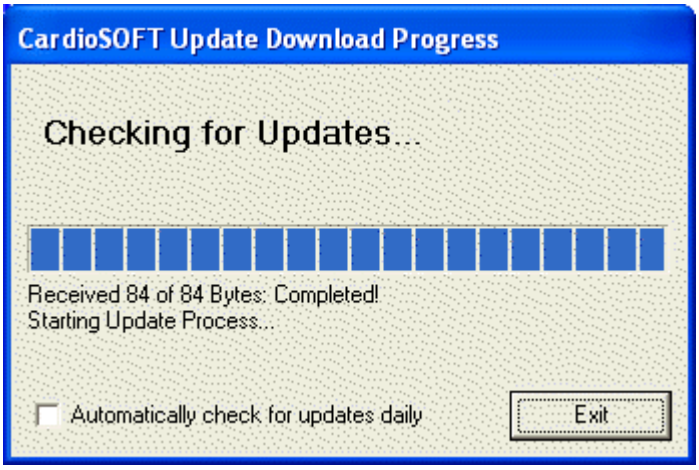
1) Select Repair From SonoSOFT Setup window and press *Next->*.
2) All software will update automatically.
3) To add new software features or programs, please select *Modify* and follow instructions as specified in Installing Software

Starting with version 3.4.30, SonoSOFT (SonoVIEW or CardioSOFT, depending on your license) has the ability to check for Updates. This is only possible if the computer has internet access. The Update process can be initiated in one of two ways:

1. Start SonoSOFT, on the main menu bar there will be an Updates menu item. Activating this button will cause the Update process to begin.
2. Start SonoSOFT, on the main menu bar select the “Help” menu and then “About SonoVIEW” or “About CardioSOFT”. This will show the About dialog:

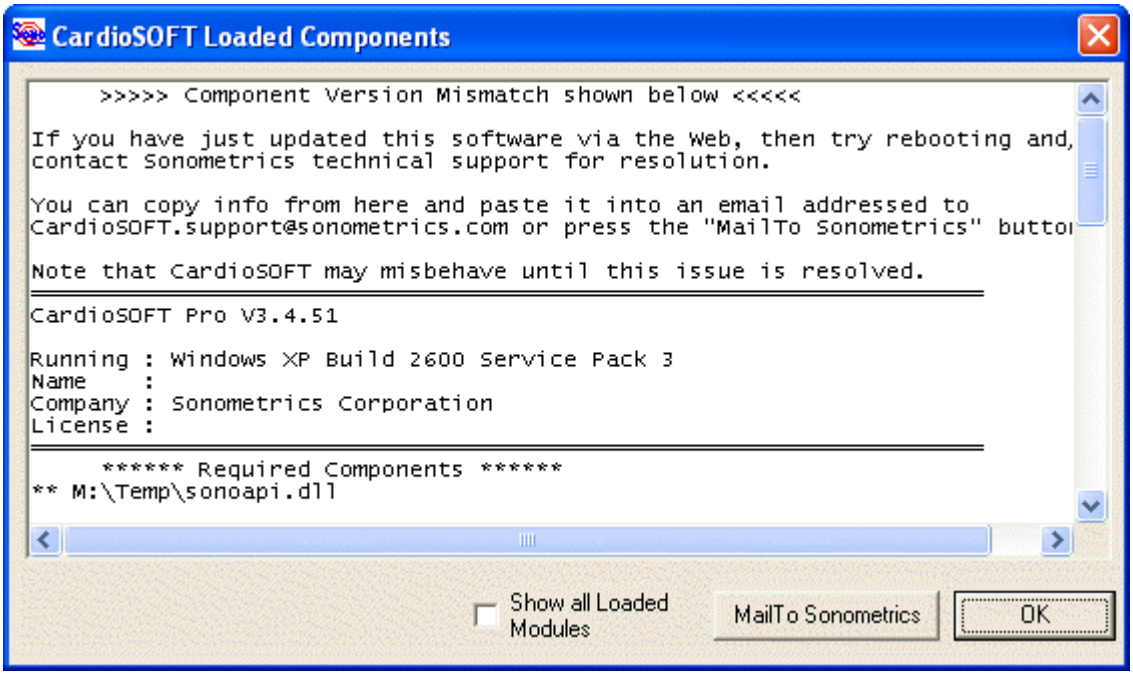


On the About dialog, activating the “Check for Updates” button will cause the Update process to begin. A progess dialog will be shown when the Update process has started:



If an update is available, another dialog is presented which will ask the user if they wish to proceed with the update process.

NOTE: if after the update has completed, when you start SonoSOFT, a message appears indicating that there is a Component Version Mismatch issue, you should restart your computer. The mismatch dialog is similar to:



If after the restart, the mismatch issue persists, contact Sonometrics.

Operating Other Software from SonoSOFT Platform

Operating Other Software from SonoSOFT Platform

Links to other software programs or new SonoLAB configurations can be made on the SonoSOFT platform.

1) Select *File* from the SonoSOFT Platform.
2) Select *Add*.

3) To add a different SonoLAB Configuration please enter the following:

Menu Text: SonoLAB X where X is the number of TRX channels.

Command Line: C:\SonoSOFT\DOS\SonoLAB.exe sonolabX.cfg

Working Directory: C:\SonoSOFT\DOS

4) Press *OK* and select *SonoLABX* from the *New Data Acquire* menu.

5) When prompted by SonoLAB, enter the appropriate channel numbers, analog numbers, resolution and DAC availability.

The new SonoLAB will remain in the system until deleted by the user.

Working in SonoSOFT

Working in SonoSOFT

As Sonometrics moves to a complete windows based system overlap between software capabilities and function will occur. Currently SonoLAB acquisition software is DOS based software with all data processing performed in windows. In this time of transition we thank you for your patience.

For more information, please select from the following:

1) About the SonoSOFT Platform

2) Acquiring Data

3) Opening Files in SonoVIEW.

4) Setting up Display.

5) Preparing for Data Analysis.

6) Performing Calculations in SonoVIEW and CardioSOFT.

7) Saving Files in SonoVIEW.

8) Printing Files in SonoVIEW.

9) Trouble Shooting SonoSOFT.

About SonoSOFT Platform

About SonoSOFT Platform

The SonoSOFT platform serves as the platform for all software. The platform contains links to data acquisition software, processing software, basic help documents and tutorial documents.

1) Online Help Documentation.

2) Computer Hardware and Software Information.

3) SonoVIEW Tutorial.

4) Licensing Information.

Online Help Documentation

From the SonoSOFT platform, the Help documentation for acquisition and analysis may be accessed from the *Help* drop menu. A full copy of the Hardware and Software manuals may be accessed from the SonoSOFT icon shown in the program files.

Computer Hardware and Software Information

To access software information such as version number:

1) Select *About SonoSOFT* from the *Help* drop menu.
2) The newly opened window will give information about version number, license information and the name of the licensed user.
3) Select *System Info* in the *About SonoSOFT* window to view system resources.

SonoVIEW Tutorial

For new SonoVIEW users, an online tutorial is available from the *Help* drop menu. This tutorial may be downloaded from Sonometrics web page at http://www.sonometrics.com/new_soft-cus.htm.

Licensing Information

Upon opening the SonoSOFT platform a licensing statement outlining legal statements and Copyrights of Sonometrics Corporation can be found. The Licensing Agreement must be accepted before SonoVIEW will open. To review the licensing agreement at any time:

1) Select *Help* from SonoSOFT platform.
2) Select *Show EULA at Startup* and restart the SonoSOFT platform

Acquiring Data

Acquiring Data

SonoLAB DOS software and *Data Convert* may now be accessed from the *File* drop menu on the SonoSOFT Platform. For assistance in running SonoLAB and common questions, please go to Acquisition Help documentation.

Opening Files

Opening Files

SonoVIEW may be opened from the SonoSOFT platform or desktop links. From the *Open* window, a numerous file types may be select. Please see got to Appendix A File Extensions to see definitions of all file types.

In the Open window, scroll through folders to locate the appropriate file. Once located select file type:

1) To select a raw data file not previously opened in SonoVIEW, the file extension, *Old SonoLAB Binary (*.**b)* must be chosen in the drop menu at the bottom of the window.
2) To select a file previously opened but not manipulated in SonoVIEW, select *SonoLAB Binary Data (*.slb)*
3) To open files previously manipulated in SonoVIEW (calculations, filtering) select *SonoSOFT Binary Data (*.ssb)*
4) To open ASCII Files, select *Trace ASCII Data (*.ssa)* or *Cardiac ASCII Data (*.sca)*

SonoVIEW Display

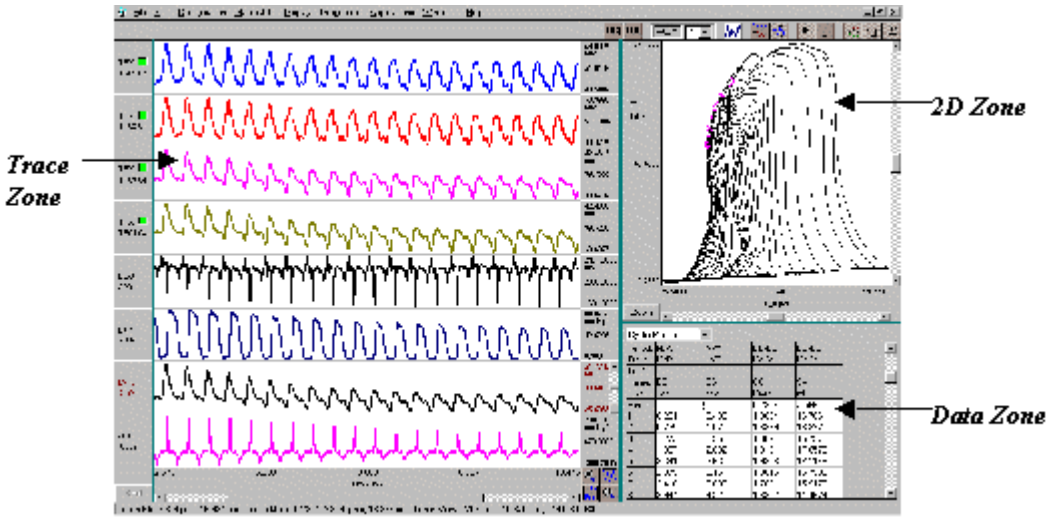
SonoVIEW Display

To determine the quality of data gathered, the user can select both crystal channels and ADC channels to be viewed. The only limit to the number of traces viewed, is the size of the computer monitor.

As shown there are three display Zones within the SonoVIEW platform,

1) Trace Zone.
2) 2D Zone.
3) Data Zone.
4) Display Settings.

Trace Platform Window Labeling



Trace Zone

Trace Zone

The Trace Zone shows trace properties. There are four trace types to make up this zone.

1) Crystal Traces.
2) Analog Traces.
3) AUX Traces.
4) Merged Channels.

Crystal Pair Traces

When saving data, SonoLAB saves all possible crystal combinations, both transmitting and receiving unless specified by the user. All possible combinations of crystals may be scrolled through in the Trace Window and manipulations may be viewed.

Analog to Digital (ADC) Traces

SonoLAB acquisition software allows the user to input and save analog signals with crystal measurements. Within SonoVIEW, the user may view signals in correlation with dimension measurements and one another. Filtering capabilities are also available for analog signals.

Auxiliary Traces (AUX)

The definition of an auxiliary channel is a channel calculated from other channel(s). These calculations are performed on each sample of data to create a complete waveform. For more information on creating AUX channels, please see page Performing Calculations.

Merged Traces (MERGE)

In SonoVIEW, multiple traces may be copied together a single trace window. The merged traces may be used to view differences in the trends of the data. For more information on creating merged channels Copying and Merging Traces.

2D Zone Window

2D Zone Window

Within the display window, the user may customize a two dimensional graph using any combination of TRX channels, ADC channels and/or AUX channels to define the X and Y-axis. In the 2D Zone, calculations using loop analysis may be viewed.

To set 2D Display Settings

Data Zone Window

Data Zone Window

The Data Zone uses multiple spreadsheet formats to view numerical values and calculated parameters. Entries to the Data Zone are organized into different spreadsheets for easy access to data calculations. All files may be exported to ASCII format, both trace data and calculated data may be exported to ASCII file format. ASCII files may be opened as text files in spreadsheet format. For steps to creating ASCII files please see page Saving Files in ASCII Format.

Display Settings

Display Settings

SonoVIEW allows the user to customize the number of windows and the specifics of information contained within. To customize the display further please select from:

1) Setting Zones to View.

1) Trace Zone.

2) 2D Zone.

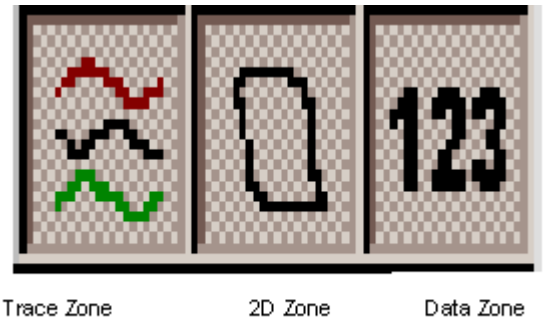
3) Data Zone.

4) Time Scale Settings.

Selecting Zones to View

The user may wish to view one or more of the three zones. In the upper right corner of the platform are three buttons symbolizing the Trace Zone, 2D Zone and Data Zone. Using the mouse, click the buttons to remove or add display zones. When one display zone is removed, the others will resize and fill the space.

Figure 1: Buttons to Select Zones to View



Time Scale Settings

To adjust time scale settings in the Trace Zone:

1) Right click along the time scale located at the bottom of the display screen. The Time Scale Settings window will open.
2) Reset the decimal places using the precision drop menu.
3) Manually enter the upper and lower time limits using the Bounds menus.

Trace Zone Settings

Trace Zone Settings

2) Display Templates.
3) Customizing Number of Channels to View.
4) Setting Trace Propteries.
5) Scrolling Through Traces.
6) Scale Settings.
7) Setting the Number of Decimal Places.
8) Time Shifting Traces.
9) Viewing Delineators.

Using Display Templates

When opening a file in SonoVIEW the user may wish to use a previous template.

1) Select *Configuration* from the top menu
2) Choose *Open Template*, *Default Template* or *Latest Template*.
    a) The *Default Template* is a standard display showing one of each trace type.
    b) Latest Template, the user may choose the template of the last data file. Choosing a previous template, all display aspects are updated.
    c) Open Template allows the user to open a previously saved template of specific configuration.

Setting the Number of Channels to View

Only the computer monitor limits the number of traces viewed in the Trace Zone. With most applications, only specific crystal pairings are of interest to the user.

To select the number of traces:

1) From *Display* menu.
    a) Select *Number of TRX* and select number of traces from side window.
    b) Select *Number of ADC* and select number of ADC traces.
    c) Select *Number of AUX* to select number of calculated traces.
    d) Select *Number of MRG* to select number or merged traces.
2) From short cut located in the upper right corner of the platform.
    a) Left click on the channel type name, *TRX, ADC, AUX or #MRG*
    b) Select number of traces from drop menu located to the right.
    c) To change trace type, left click on the *Trace Type* window and a hidden menu will appear to select from.

Setting Trace Properties

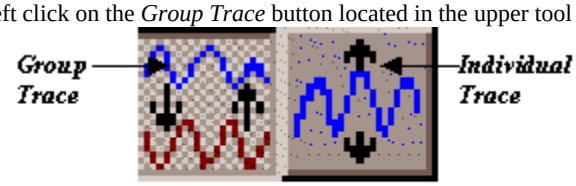
The customization of the trace window may include Trace Color, Trace Style and Trace Width. To specify trace properties:

1) Right click on a trace to open the *Trace Properties* menu.
2) All trace properties may be redone using the *Redo Trace Setting* for one trace, all traces in a group or all traces in the file.
3) Any changes to the trace settings may be undone using *Undo Last Setting*.

Trace Scrolling

To determine the quality of data collected the integrity of individual traces must be viewed. To scroll through traces:

1) Left click on the *Group Trace* button located in the upper tool bar.



2) This will activate a scroll bar spanning all channels of each trace type.
3) To the move scroll bar to another trace group, left click in the right margin opposite the trace group to be chosen.
4) When scrolling, all possible traces are viewed unless the channel has been turned off (to select traces viewed please see Selecting Traces to View

Scale Settings

Vertical scales may be set uniformly or while the horizontal or time scale, is uniform throughout. Scales may be set using the four buttons located in the bottom right corner of the *Trace Zone*.

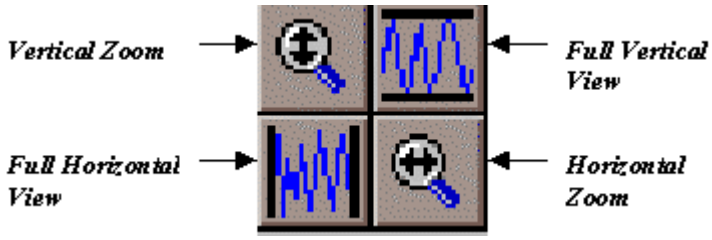
Buttons:

1) Full Horizontal View button in the lower left corner will reset the horizontal scale of the trace window to show the entire trace from beginning to end.

2) Horizontal Zoom in lower right corner allows for incremental increases and decreases in horizontal scale. Position the cursor in the *Trace Zone* and left click to zoom in and right click to zoom out. To increase zoom increments, hold down the *Control* key in combination with mouse.

3) Full Vertical View button in the upper right corner will auto-scale the upper and lower limits of the trace contained within the screen.

4) Vertical Zoom button is located in the upper left corner and allows for incremental increases and decreases of the vertical scale. To increase zoom increments, hold down the *Control* key in combination with mouse.



To set known upper and lower scale values please go to Setting Specific Scale Values.

Setting Decimal Places

The number of decimal places for all trace types may be from zero to seven digits. To change the number of decimal places:

1) Open the *Scale Settings* windows by left clicking in the right margin of the trace.
2) Using the *Precision* drop menu set the number of decimal places.
3) Changes may be applied to individual traces, all traces of a particular group or all traces by choosing the corresponding radio dot.

Shifting Individual Traces

To shift a trace, the user may manipulate horizontal time scales. A time shift will add zero data to the beginning of a trace or delete data from the end, depending on the type of time shift.

1) To determine the number of data points to shift, please see Selecting Sections of Data.
2) In the *Scale Settings* window enter the number of data points, positive or negative to shift the trace.

Viewing Delineators

Delineators are used by SonoVIEW to determine the number of cycles/beats in a file. Any type of trace, TRX, ADC or AUX can be used as delineation trace. Delineators may be viewed in the *Trace Zone* and *2D Zone* as corresponding lines or crosshairs. For more information on Delineation, please go to Choosing Delineators.

To view delineators:

1) Select Delineation from the upper menu and select from available options.
2) Delineation choices will correspond to the type of delineation used. Select from highlighted choices.

Setting Trace Properties

Setting Trace Properties

The customization of the trace window may include Trace Color, Trace Style and Trace Width. To specify trace properties:

1) Right click on a trace to open the *Trace Properties* menu.
2) All trace properties may be redone using the *Redo Trace Setting* for one trace, all traces in a group or all traces in the file.
3) Any changes to the trace settings may be undone using *Undo Last Setting*.

Trace Colour

Within the trace window, the user has the choice of 12 different colors.

1) right click on the trace to be altered to open *Trace Properties Menu*.
2) Select *Trace Color* and choose from list.
3) When a file is closed the color scheme will also be saved.

Trace Style

Traces may be viewed as a solid line or as individual data samples. Traces viewed with Line option will see the trend of a trace including possible outliers or inconsistencies. Viewing the traces with Dot option will show the distribution of the data samples. The distribution of the data points may assist the user in determining level shifts and other data irregularities.

Trace Width

The optimal width to view traces is dependent on the computer monitor and trace detail. *Trace Width* settings show traces of different thickness selected by the user and saved with the data file.

Selecting Traces to View

Selecting Traces to View

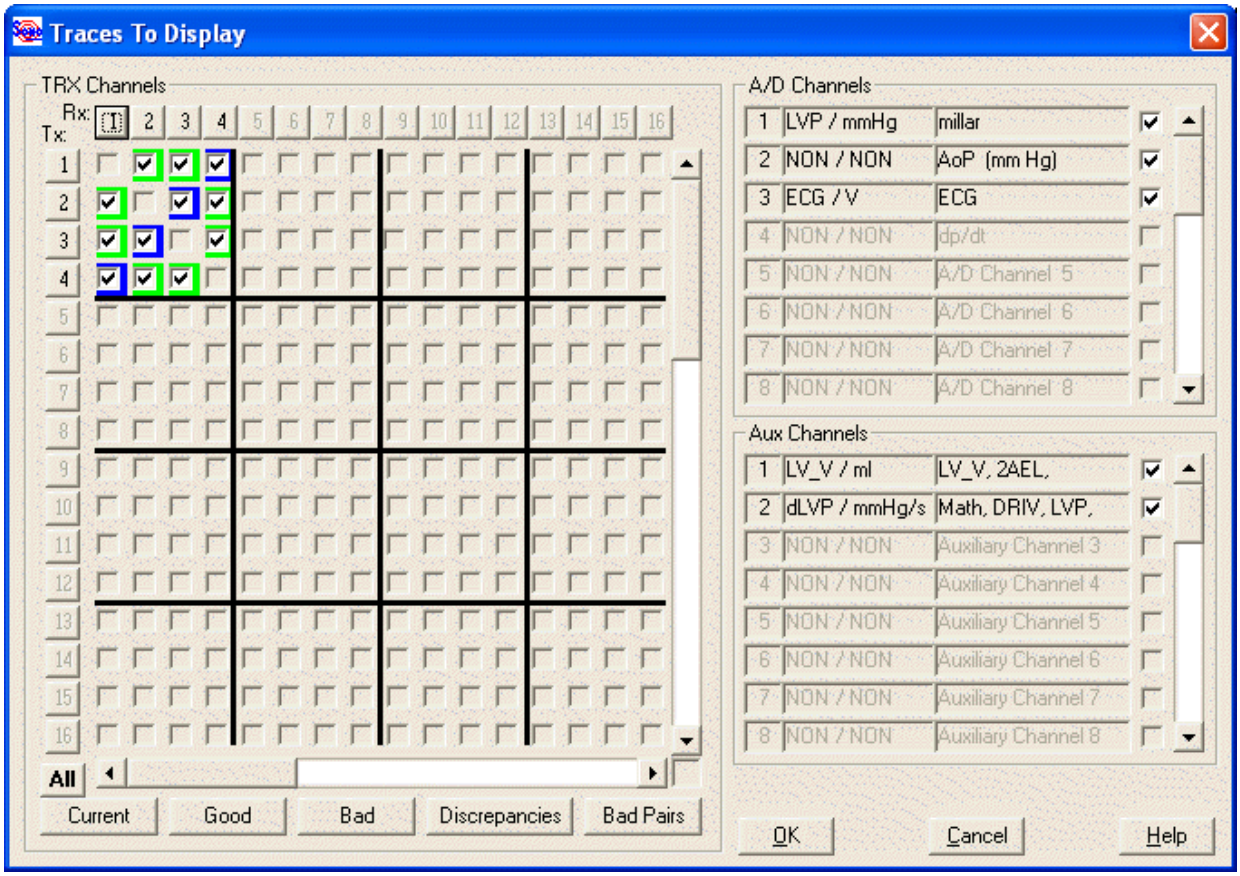
The number of traces to view may be selected from the:

1) Trace Matrix.

2) Trace Zone.

Channel Display from Trace Matrix

To select crystal pairs to view, select from the *Trace Matrix*:



1) Select Display from the upper menu followed by Trace Matrix.

2) From the opened grid, left click to turn crystal combinations off or on. Only checked combinations will be shown in Trace Zone.

3) To add or remove all combinations, click *All* in the lower left corner.

4) To remove a crystal column or row, click on the written number of that channel.

5) To show only Good, Bad or Unknown Traces, please click on the *Trace Quality Selection Box* next to the horizontal scroll bar located below the crystal pair matrix. The following Buttons have been added to the Trace Matrix dialog:

- "Current" - show the TRX Channels to the currently active selections
- "Good" - show the TRX Channels to show only those TRx channels that have been marked as Good
- "Bad" - show all TRX Channels that have marked as Bad
- "Discrepancies" - show the TRX Channels that have been marked as Good but for which a discrepancy exists between the TRX pairs (i.e. TR01:02 and TR 02:01). A further explaination is given below.
- Bad Pairs – show only TRX Channels where the TRX pairs have both been marked as Bad.

6) Turn on or off ADC and AUX channels as appropriate.

The Trace Matrix dialog has been modified so that the TRX Channels are color coded:

1. Blue indicates a TRX trace that is marked as Good, however, there is a discrepancy greater than the predefined Threshold for the Trace pair. A Mouse-Over the blue control will display a tool-tip text indicating the number of time points where the difference between the TRX pair are greater than the Threshold value (called Discrepancies).

   The threshold value is set to 2.0 mm by default. The value can be modified for the current session by selecting the "Configuration", "SonoAPI Parameters …" menu item. The SonoAPI Parameters Configuration dialog under the "Threshold" tab will provide the mechanisms for changing the value
2. Green indicates a TRX trace that is marked as Good
3. Red indicates a TRX trace that is marked as Bad.

The marking of the TRX Channels as Good or Bad is important if you are using the file in SonoXYZ analysis.

Channel Display from Trace Zone

When viewing traces the user may decide not to view a specific trace. A shortcut is available within the *Trace Zone* to hide traces.

1) To hide, right click in the margin of the trace to open the *Channel Settings* window.

2) In the lower region of the window is a *Hide Trace* button. When this button is clicked the trace will be turned off in the display window and the in the *Trace Matrix*.

3) These traces are only reactivated from the *Trace Matrix* that may be accessed from the *Channel Settings* window.

Scale Settings

Scale Settings

Vertical scales may be set uniformly or while the horizontal or time scale, is uniform throughout. Scales may be set using the four buttons located in the bottom right corner of the *Trace Zone*.

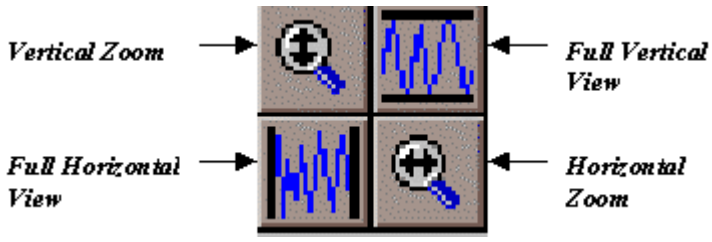
Buttons:

1) Full Horizontal View button in the lower left corner will reset the horizontal scale of the trace window to show the entire trace from beginning to end.

2) Horizontal Zoom in lower right corner allows for incremental increases and decreases in horizontal scale. Position the cursor in the *Trace Zone* and left click to zoom in and right click to zoom out. To increase zoom increments, hold down the *Control* key in combination with mouse.

3) Full Vertical View button in the upper right corner will auto-scale the upper and lower limits of the trace contained within the screen.

4) Vertical Zoom button is located in the upper left corner and allows for incremental increases and decreases of the vertical scale. To increase zoom increments, hold down the *Control* key in combination with mouse.



To set known upper and lower scale values please go to Setting Specific Scale Values.

Setting Specific Scale Values

Setting Specific Scale Values

To set specific upper and lower limits of a trace:

1) Select Individual Trace button and select trace.
2) Right click in the margin to open the *Scale Settings* window.
3) The upper and lower slide bars are used to increase or decrease the scale limits.
4) The user may select the *Auto Scale* button in the lower left corner of the *Scale Settings Window*.

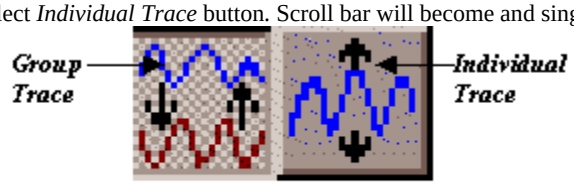
Also See:

1) Setting Decimal Places (Precision).
2) Time Shift Points.

Trace Magnitude

The *Individual Trace* button allows user to change trace amplitude individually.

1) Select *Individual Trace* button. Scroll bar will become and single trace scroll bar.



2) Select a trace by left clicking on the trace.
3) The *Trace Magnitude* scroll bar will now be positioned within the upper and lower limits of the trace allowing the user to alter upper and lower limits. For more information on vertical scale settings and single trace manipulation, please see page Scale Settings.

Shifting Individual Traces

To shift a trace, the user may manipulate horizontal time scales. A time shift will add zero data to the beginning of a trace or delete data from the end, depending on the type of time shift.

1) To determine the number of data points to shift, please see Selecting Sections of Data.
2) In the *Scale Settings* window enter the number of data points, positive or negative to shift the trace.

Setting Decimal Places

The number of decimal places for all trace types may be from zero to seven digits. To change the number of decimal places:

1) Open the *Scale Settings* windows by left clicking in the right margin of the trace.
2) Using the *Precision* drop menu set the number of decimal places.
3) Changes may be applied to individual traces, all traces of a particular group or all traces by choosing the corresponding radio dot.

2D Zone Settings

2D Zone Settings

Within the 2D-Zone, the user may select any channel combination on an X-Y axis. In this window, trends in data may be seen along with corresponding calculation lines.

1) Selecting the XY Axis.
2) Setting XY Scale.
3) Viewing Delineations and Calculations.

Selecting the XY Axis

Traces used in the 2D-Zone may be changed at any time and the display screen may be printed directly. To select the X and Y-axis:

1) Select *Configuration* from the top menu followed by *2D-Zone* or left click within the *2D Zone*.
2) Select traces type radio dot for each axis.
3) Select trace to use from the drop menu for each axis.
4) Press *OK* or *Apply*. When *Apply* is pressed, the 2D graph will update but the *2D Zone Configuration* menu will remain open. If *OK* is clicked the *2D Zone Configuration* window will close.

Viewing Delineations and Calculations in 2D Zone

Using the advanced analysis software CardioSOFT, the user can perform calculations relating to trends of a graph. Such calculations will be listed in the *2D Zone Configuration* menu when calculated. To include a listed calculation:

1) Highlight the name of the calculation and click the <- button.
2) The name will move from the *Excluded* list to the *Included* list.
3) Calculations listed in the *Included* menu will be shown in the *2D-Zone*.
4) Removed calculations by highlighting the name and using the -> button to shift calculation name back to the *Excluded* list. For information on calculating values see Performing Calculations.
5) When delineators are enabled in the Trace Zone, the corresponding marks will also appear on the 2D Zone.

Setting XY Scale

Setting XY Scale

To set 2D scale, the *Zoom* features, *Auto Scale or Independent Scale Settings* may be used.

1) Zoom Features.
2) Scale Settings.
3) Independent Scale Settings.

Zoom Feature 2D Graph.

The zoom features operate similar to the zoom features in the *Trace Zone*. To activate, left click on the Zoom button to open and reveal the four buttons. For information on scaling buttons, please Trace Zone Scale Settings .

Independent Scale Settings in 2D Zone

The user may enter specific scale settings for the window. To open the *2D Graph Scale Settings Window*, right click in the margin along the X or Y-axis. This window will set the scale for the corresponding axis used to open the window.

1) To change axis scaled, click the *Y-axis* or *X-axis* radio button located in the lower right corner of the *2D Zone Scale Settings Window*.
2) To change the number of decimal places used in the 2D Graph, select from *Precision* drop menu. *Precision* may be set for each axis independently or for both axes as specified from *Precision* window.

Data Zone Settings

Data Zone Settings

Numerical output of data is an integral part of any experiment and subsequent analysis. Since such a large amount of data may be generated during processing, SonoVIEW has separate spreadsheets. From the drop menu located in the upper left corner of the *Data Zone* the user may select the following spreadsheets to view.

1) Trace Data Spreadsheet.
2) Cyclic Parameters.
3) Complex Parameters.
4) Spectra .
5) Manual Parameters.

Trace Data Spreadsheet

Trace Data spreadsheet contains numbers corresponding to data samples. To view all data samples of all displayed traces simply click on the *Value* radio dot located in the upper right corner of the spreadsheet.

The top row in the spreadsheet is labeled as *Num*. in the left margin. These numbers correspond to the number of data points listed in the spreadsheet per trace. Below Num., entries are the Avg. or average value. These numbers correlate to the average measurement value of all samples of data displayed in the window for that trace.

Cyclic Parameters Spreadsheet (CardioSOFT Users Only)

Data trends may be seen and calculations made. Within the *Cyclic Parameters* spreadsheet repetitive calculations may be viewed. Numerical representation of delineators is an example of data displayed in this spreadsheet.

Complex Parameters Spreadsheet (CardioSOFT Users Only)

More advanced cardiac calculations may be seen in the *Complex Parameters* spread sheet. Such calculations generate a single value. The analysis package purchased will determine if this spreadsheet is available.

Spectra Spreadsheet (CardioSOFT Users Only)

Within the *Spectra* spreadsheet, specific calculations are viewed such as arterial impedance and Fast Fourier Transform calculations. Calculations will be listed in this spreadsheet with in correspondence to each beat.

Manual Parameters Spreadsheet

The *Manual Parameters* spreadsheet will only display data if Manual Delineation is selected in the Analysis platform window and both the “Max/Min->ED/ES” and the “Min/Max->ED/ES” check boxes are **not** checked. The Manual Delineation defined by this configuration will display the maximum, minimum and mean values within each periodicity range. The default periodicity is 150 sample points.

In *Manual Parameters*, data points of all other traces at the time of delineation will be listed. For each delineator, the value at the maximum delineation point, minimum delineation point and the mean measurement of the defined cycle. Other parameters may be specified from the *Parameters* drop menu on the Analysis platform.

Preparing For Data Analysis

Preparing For Data Analysis

SonoVIEW has extensive filtering capabilities, channel selection assistance and data series customization available to the user. The following outline the initial steps suggested before analysis begins.

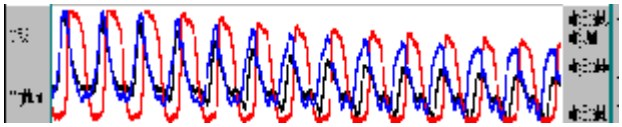
1) Naming Channels.
2) Selecting Sections of Data for Calculations.
3) Filtering Data.
4) Copying and Merging Traces.

Copying and Merging Traces

To copy a single trace or multiple traces into a new trace window the user may select traces individually. To copy a trace:

1) Highlight the trace in question by clicking anywhere on it.
2) To select second trace, hold down the *Control* key and left click on the subsequent traces to selected.
3) When all traces are selected, choose *Copy (Control “C”)* from the *Edit* drop menu followed by *Paste*.
4) A new trace will be created at the bottom of the screen containing all traces selected.

Example of Merged Traces



Merged or copied traces cannot be saved with file and will disappear when file is closed. All other changes to trace will be saved as *.ssb files.

Naming Data Channels

Naming Data Channels

The naming of data channels is imperative when carrying out calculations in SonoVIEW and CardioSOFT. The user must label all TRX and ADC channels manually or by using templates. The naming of the crystal channels is currently for cardiac applications only with the ability to enter user descriptions. To access the *Channel Settings* window:

1) Right click in the left margin of the Trace Zone window.
2) From *Analysis* platform:

a) Select radio dot corresponding to type of trace to be named.

b) Select trace

c) Click Properties button.

To name:

1) Naming Crystal Channels.

2) Naming ADC (Analog) Channels.

3) Naming AUX Channels.

4) Naming Channels with a Template.

Naming ADC (Analog) Channels

Access the *Channel Settings* window from the

1) Trace Zone by right clicking in the margin.

2) From *Analysis* menu.

a) From Analysis menu, the user may select the ADC radio dot

b) Select channel to name.

c) Click *Property* button to open window.

The ADC Channel Settings window consists of two drop menus with the SonoLAB description entered in the lower window. From the top drop menu, the user may scroll through signal names and select appropriate one. If name is not listed the user may select the *User's Description* and type a name.

The second drop menu includes the *Units of Measurement*.

The naming information is important to allow SonoVIEW and CardioSOFT to recognize traces. All channel names and units will be displayed in the Trace Zone once saved.

Naming AUX Channels

Although the software will automatically name all AUX channels calculated, the user may wish to alter these names. This can be done from the *Channel Settings Window* opened from the Trace Zone or from the *Analysis* platform.

Once the *Channel Settings Window* is open, select names from the upper drop menu and appropriate unit of measurement for the lower menu. Once saved the new names will overwrite the previous labels in the Trace Zone.

Naming Channels Using a Template

To save time during data processing, SonoVIEW is capable of naming all channels using a previously labeled template. Once named in SonoVIEW, a file can be used as template to name other files with identical channel set up. To access the template feature:

1) From the *Channel Settings Window*, click the *Header Template* button to open the *File Open* window.

2) This window will allow the user to move through file folders to select a file to use as a template.

3) Press *Open*.

4) The *Channel Settings Window* will appear with the names entered automatically.

5) Select *Save* and the names will be saved with the file for all channels.

6) To name TRX or ADC channels only, click the *Header Template* radio dot to toggle on and off channel types to be named.

Naming Crystal Channels

Naming Crystal Channels

Crystals must be labeled to reflect placement. Note*: each crystal must be labeled only once per file. To assist in placement naming, the crystal name entered during acquisition in SonoLAB will appear in the lower portion of the window.

Please note that there is a help diagram available by clicking the *Heart View* button located in the bottom right of the window. Once the four drop menus are selected press *Save*.

For assistance in naming:

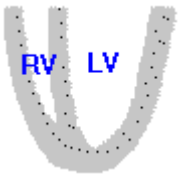
1) Selecting Units of Measurement.
2) Select Ventricle Drop Menu.
3) Select Long Axis View.
4) Select Short Axis View.
5) Select Depth View.

Units of Measurement

The default unit of measurement of a dimension channel is millimeters (mm) as acquired in SonoLAB. Due to this automatic setting, the user will be unable to change the unit of measurement.

Select Ventricle Drop Menu

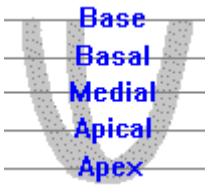
The upper right menu, select the right or left ventricle of the heart. From this drop menu, the user may also select *User's Description* and manually enter a name. For assistance in placing crystal please refer to *Heart View* button and window (see Naming Crystal Channels)



Select Long Axis View Drop Menu

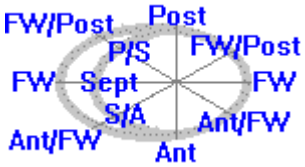
Long axis view is the placement of a crystal if the heart was cut from apex to base. For a visual representation please view the diagram accessed from the Heart View button as discussed in Naming Crystal Channels .

For crystals defining long axis, be sure to assign then *Apex* and *Base* to assist SonoVIEW in identification. For crystals defining the short axis, name each as *Medial* placement to identification as directly corresponding crystals.



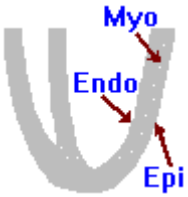
Select Short Axis View Drop Menu

To identify the short axis the user must identify the crystal placement on the horizontal axis. The *Short Axis View* represents the placement of crystals on a cross section of the heart. Again, the use of the Heart View button to show corresponding placement is recommended.



Select Depth View Drop Menu

The placement of crystals during the experiment on the *Endocardial* surface, within the *Myocardial* tissue or against the *Epicardial* surface may also be labeled in SonoVIEW.



Selecting Data Sections and Beats

Selecting Data Sections and Beats

Within a data file, only a section of the file may be used as opposed to the entire file. SonoVIEW allows the user to highlight continual sections of data for use in calculations along with the ability to exclude or 'turn off' sections or specific beats.

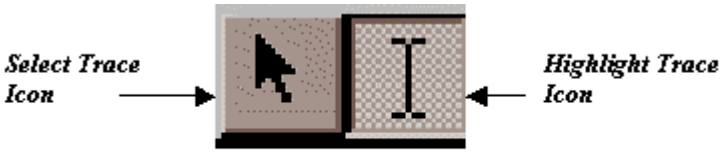
1) Selecting Continuous Sections of Data.
2) Selecting Separate Sections of Data.
3) Removing Specific Beats.
4) Removing Sections of Data from 2D Zone.
5) Chopping Large Data Files.

Selecting Continuous Sections of Data

The user may highlight large sections of the file, a single point of data or the entire file length. The highlight feature may be used for filtering as well as calculations. To use the entire trace do not highlight any sections of trace.

To select a section of data:

1) Select *Highlight Trace* from the *Display* drop menu or the *Highlight Trace* icon located in the upper right corner of the SonoVIEW platform.



2) When *Highlight* is activated, crosshairs representing mouse placement in the *Trace Zone* will appear. The vertical crosshairs represent the point in time with corresponding numerical data shown in the *Data Zone*.
3) Position the mouse on the beginning or ending section of data and hold down the left mouse key while dragging the cursor across the screen.
4) Once a section is highlighted, numerical representation in the Data Zone will show the number of data points selected and the average measurement of points for each tracing.
5) To remove the highlight, choose *Select Trace* icon from the upper right corner of SonoVIEW platform or the *Select Trace* option from the *Display* menu.
6) The highlighted area may be changed at any time by reselecting it

Selecting Separate Sections of Data

In some files the user may wish to use separated sections of data. To highlight separate sections of data:

1) Highlight the initial section see Selecting Continual Section of Data.
2) Select other sections by holding down the *Control* key and highlighting again.
3) Both sections will remain highlighted until changed or highlight is turned off.

Removing Specific Beats

With the use of Delineators, beats and or sections of data may be “turned off” within the trace. Remove of internal sections will result in automatic updating of calculations without recalculating.

To remove beats:

1) Turn on delineators from Delineation menu. To calculate delineators please see page Choosing Delineators.
2) Turn on the TOG button.
3) Position mouse above section to be removed and left click. Section will now be greyed.
4) To reactivate section of data, left click over greyed area.
5) Removal of delineators or addition of delineators will return any greyed areas.

Removing Sections of Data from the 2D Zone

When delineators are activated, individual loops may be removed from both the 2D Zone and the Trace Zone.

1) Position the cursor in the 2D Zone over loop to be removed.
2) Left click and the loop will become yellow. (this may be a very exact mouse placement. If loop does not highlight, zoom in to increase scale and loop dimension)
3) Still positioned above highlighted yellow loop, right click and select *Remove Highlighted Segment.*

4) This section of the loop will disappear along with the corresponding section of the Trace Zone.

Chopping Large Data Files

Some data saves may be very long making analysis difficult or sections of the data file may be useless. For these cases, the user may 'chop' a section of data to be saved as a separate file. Each new shortened file will be saved with an "s" character added to the name or the user may rename the file.

To chop an active trace:

1) Using the Zoom features (see Scales Setting) center essential data in main display window.
2) From the *Manipulate* drop menu select *Chop Visible Data*
3) A *Save As* prompt will be seen with the file name. The new file name will have an extension added, i.e. exp01.slb will become exp01s.slb.
4) Press *Save* and the new chopped data section will remain opened in the display screen.
5) If the file is to be chopped again, another "s" extension will be added i.e. exp01s.slb will become exp01ss.slb and so on.

Filtering Data Channels

Filtering Data Channels

During data collection, noisy signals are possible. SonoVIEW has the ability to filter both TRX and ADC channels along with AUX channels if needed. All filtering functions may be accessed from the *Manipulate* drop menu and key combinations. Since filtering capabilities vary for TRX and ADC channels some filtering options will vary in application.

Once files are filtered, the user will be prompted to resave the file in the .slb format. This assures the user will not overwrite raw data. Once a file is saved as .ssb file, SonoVIEW will continue using this file. For later analysis of this file, the .ssb format should be opened.

Features:

1) Selecting Crystal Size-Shift +F2.
2) Setting Traces as Good, Bad or Doubtful.
3) Undoing Filter.

Types of Filters:

1) Remove Outliers of Active Trace - F2.
2) Remove Outliers of all Selected TRX Traces - Control + F2.
3) Replace Highlighted Points in Active Trace - F3.
4) Replace Outbound Points of Active Trace - F4.
5) 3 Point Average of Active Trace - F5.

Selecting Crystal Size-Shift+F2

When filtering, a window will appear urging the user to select the crystal size whenever *Remove Outliers of Active Traces (F2)* or *Remove Outliers of all Selected TRX Traces (Conrol+F2)* are selected.

To select crystal size the user has four options.

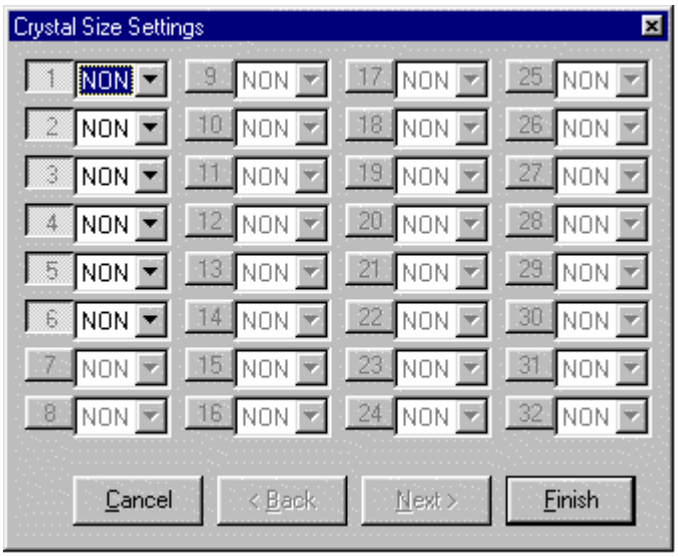
1) LRG represents large including 2mm crystals or larger including.

2) SML refers to small crystals, between 1-2mm in size.

3) MIC represents Sonometrics 0.75mm crystals.

4) None may be selected if no crystal was present or as default.

5) Once done click on *Finish* and all setting will be saved.

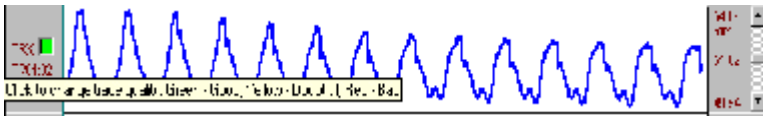


Setting Traces as Good, Bad or Doubtful

In the Trace Window, colored squares in the left margin to help the user label traces *good* (green), *bad* (red)) or *doubtful* (yellow). Trace Status may be set by computer filters or by the user themselves.

The filtering option, *Remove Outliers of All Selected TRX Traces* will select a status of all filtered traces to assist the user. Left clicking on the colored square in the left margin may change the status of the traces. This Good/Bad template will be saved with the file.

Sample of Good Trace Quality Assigned



Undoing Filter

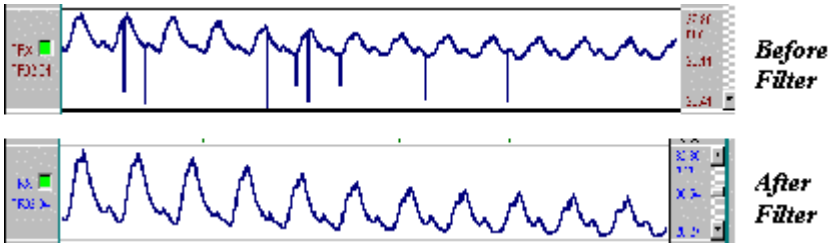
SonoVIEW has an *Undo (Control+Z)* feature accessible from the *Edit* menu. Though this function may be used at any time it can only be used once. If over filtering has occurred the user may reopen the original binary file (.slb) and begin again.

Remove Outliers of Active Trace - F2

This filtering option is similar to Remove Outliers of all Selected TRX Traces but filters an individual trace.

With this option, the computer will determine outlier points and will place them back into the trace. Outlier points affected by this filter are contained within the scaling of the trace. If a trace has too many outlier points, SonoVIEW may not recognize the outliers and an alternate method of filtering will be required.

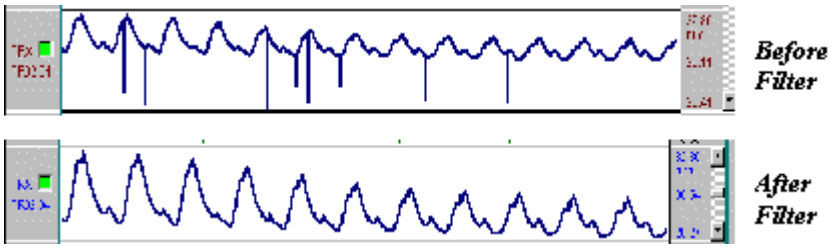
Sample Traces Before and After Removal of Outliers



Remove Outliers of all Selected TRX Traces - Control + F2

This filter affects all TRX traces that are activated within the *Trace Matrix*. When chosen this filter will recognize and reset outliers within the scale settings. In addition to filtering capabilities, this filter will set the status of crystals combinations as good bad or doubtful. Again, if outlier points are clustered or SonoVIEW is unable to identify the points as outliers another filtering option must be utilized. For an example, please below.

Sample Traces Before and After Removal of Outliers



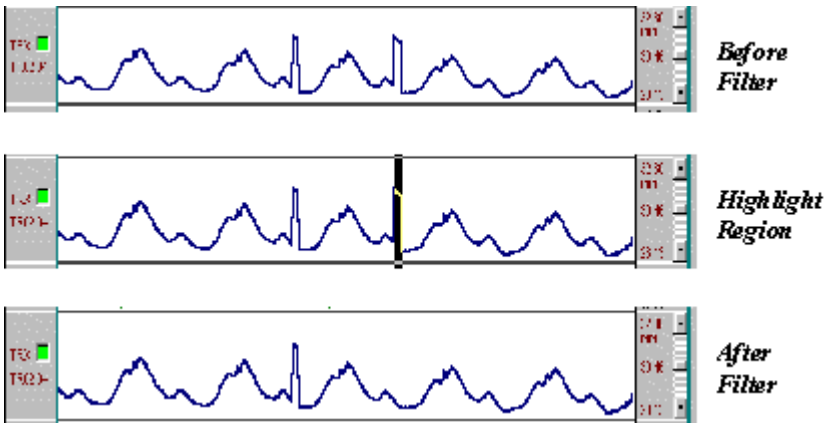
Replace Highlighted Points in Active Trace - F3

For some sections of data the user may wish more control of questionable point placement and identify outliers. This filter allows the user to select points and reposition back into the trace.

To perform these functions:

1) Select a trace and Highlight the point or series of points to reposition
2) Once highlighted select *Replace Highlighted Points in Active Trace or press F3*. The user should be aware that the repositioning of multiple points might cause inconsistencies in the data. To prevent this it is suggested that no more than five points in sequence be repositioned using this function.

Sample Traces Before, During and After Replacing Highlight Samples

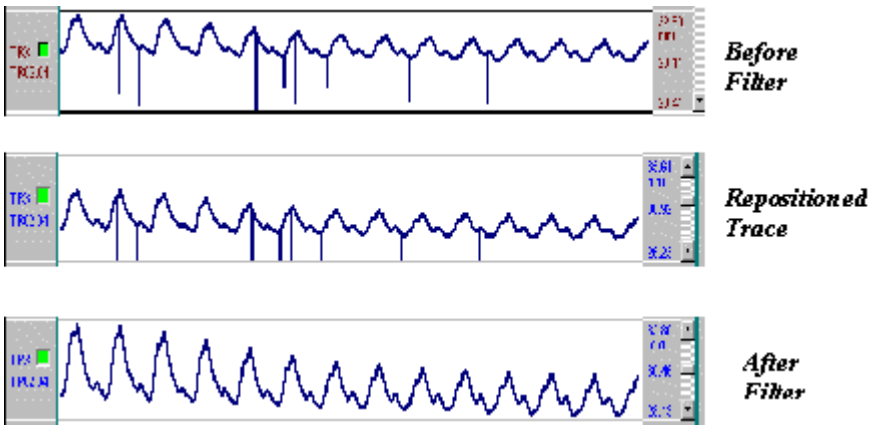


Replace Outbound Points of Active Trace - F4

Some traces may have numerous individual points above or below the trace causing SonoVIEW not to recognize them as outlier points. This filter relies on the user to identify outlier points by scrolling the trace up and down to move outlier points out of the view field (see Trace Magnitude to move individual traces).

1) Select Single Trace Magnitude and use the vertical scroll to move points out of the view field or use zoom features.
2) Select *Replace Outbound Points of Active Trace* from the *Manipulate* drop menu or press *F4*.
3) All outlying points will be placed back in the trace.

Sample Traces Before, During and after

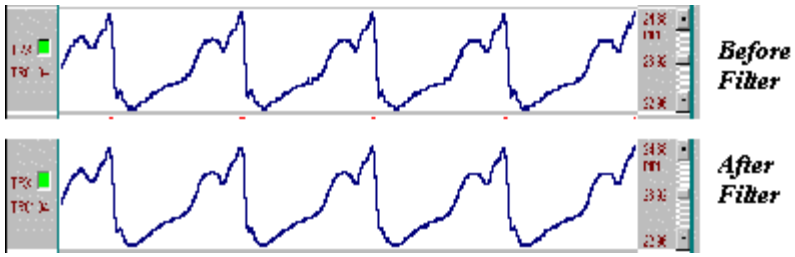


3 Point Average of Active Trace - F5

On some traces, the user may wish to use a moving filter to smooth points. This function is done to individual traces using *Three Point Average of Active Trace* from the *Manipulate* drop menu or by pressing *F5*.

Please be aware, the 3 Point Average is a very strong filter and may change the characteristics of traces with small data increments. Maximum points may be greatly decreased in amplitude if peak maximum is made of only a few data samples.

Sample Traces Before and After Three Point Average



Performing Calculations in SonoVIEW and CardioSOFT

Performing Calculations in SonoVIEW and CardioSOFT

With the evolution of Sonometrics Software, the SonoVIEW platform has become the operating platform for all processing software. From this platform, the user may open advanced software packages such as CardioSOFT, SonoVOL, and SonoXYZ and View 3D. Accessible software will depend on the package purchased.

For more information on the various CardioSOFT packages please contact your sales representative at Sonometrics or visit our website at www.sonometrics.com.

Please select from:

1) About the Analysis Platform.
2) Choosing Delineators.
3) Selecting Calculations to Perform.

Analysis Platform

To access the *Analysis* interface from the SonoVIEW platform:

1) Select *Applications* followed by *Analysis* from the top drop menu.
2) The file to be processed is displayed in the upper right corner of the platform.
3) The time length of the file or section of file to be calculated may be viewed in the upper right corner of the platform under *Time Period sec*.
4) Calculations possible within CardioSOFT and SonoVIEW may be selected from the *Parameters Menu* located to the right of the platform.
5) Select the trace type to be used in the calculation from the *Trace and Time Offset In Calculation* located in the lower right corner of the *Analysis* platform.
6) In the *Calculation Period in a Heart Beat* section determination of the beginning and end of a contraction cycle may be specified.
7) The main region of the SonoVIEW/CardioSOFT platform is the *Parameters Listing* field showing a list of all calculations to be performed.

Choosing Delineators

Choosing Delineators

The type of calculations performed will depend on delineators used. When the *Analysis* platform is opened, *Manual* or *Automatic Delineation* will be selected. The user may change the type of delineator by clicking the radio dot labeled *Automatic Delineation* or *Manual Delineation* located in the upper left corner.

The use of *Manual Parameters* will result in numerical data represented in the Cyclic Parameters spreadsheet. The use of *Min/Max* to determine ES and ED will show the time value of delineation trace.

Please select from:

1) Automatic Delineators.
2) Manual Delineators.

Automatic Delineation

Automatic Delineation

For cardiac applications, the beginning and end of the cycles are determined using end systole (ES) and end diastole (ED). For determination of ED, CardioSOFT will use ADC channels labeled *LVP*, *RVP* or *ECG*.

For determination of ES, a pressure channel may be used, most commonly *LVP*. In using LVP, ES can be determined as peak negative dp/dt, maximum LVP. Also, Emax may be used for ES determination once calculated. Please note, to use *Automatic Delineation* the appropriate ADC channels must be named.

A time offset may be applied to delineators from the *Automatic Delineation* menu. The window for applying an offset is below the selection drop menu for ED and ES delineation. The offset is a positive or negative value representing time for ES. An offset may also be applied to ED to be either R-wave peak negative or peak positive.

The offset may be viewed in the Trace Zone and 2D Zone. (see Viewing Delineators for details on viewing delineators).

Manual Delineation

Manual Delineation

Manual Delineation may be performed in one of two ways. Since not all cardiac applications may use LVP, any other trace to determine ES and ED use maximum and minimum points. For non-cardiac applications, the minimum and maximum points of a trace may be used to determine the end and beginning of a beat/cycle. In each case, the user must give an approximation to the number of data points per beat.

Type of *Manual Delineation*:

1) Manual Delineations to Determine ES and ED. (in absence of LVP trace)
2) Manual Delineation Using Minimum and Maximum.

Manual Delineation of ES and ED

To select a trace to determine ES and ED:

1) Click the *Max/Min->ED/ES* or the *Min/Max->ED/ES* check box in the upper left corner of the delineation menu.
2) Select channel type TRX, ADC or AUX by selecting the corresponding radio dot.
3) From the drop menu, select the appropriate trace.
4) The maximum value per beat will be assigned as ED and the minimum point will be ES, provided the *Max/Min->ED/ES* is checked. If the *Min/Max->ED/ES* is checked, ED is determined by the minimum value within each beat, ES from the maximum value.

Manual Delineation Using Minimum and Maximum

For non-cardiac application the user may select *Min* or *Max* located beside the *Max/Min->ED/ES, Min/Max->ED/ES* check boxes. Chose the appropriate state by activating either the *Max/Min->ED/ES* or the *Max/Min->ED/ES* check box by clicking on it. The user may choose the minimum or maximum points to identify the beat. An approximation of the number of samples per beat must be made.

From the *Parameters* drop menu located in the upper left corner of the *Analysis* platform, select to view the *Average Only*, *Minimum*, *Maximum*, *Mean*, and *Rate* for all traces. If some features are not of value, they may be turned off while others remain. The values will be displayed in the Manual Parameters spreadsheet with numbers corresponding to the value of each trace at delineation.

Selecting Calculations to Perform

Selecting Calculations to Perform

SonoVIEW and CardioSOFT allow the user not only to perform individual calculations but also to set up customized protocols including multiple calculations.

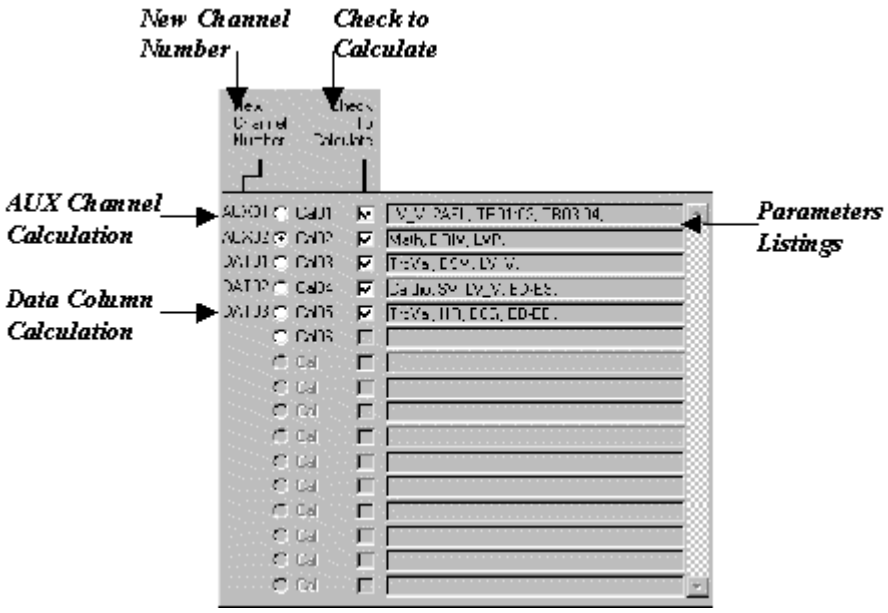
Tips:

1) Ensure the radio dot for *CALC* is selected.
2) To remove a calculation from the list the user may click the *Check to Calculate* radio dot to the left of the *Parameters Listing* window. The calculation will now be greyed out.
3) To change a calculation, select the *New Channel Number* radio dot to the left of the calculation line. Selecting another calculation will overwrite a calculation.
4) When a calculation is entered into the listing field, the corresponding AUX channel number or Data Zone column number will appear.
5) If the *Check to Calculate* radio dot cannot be activated, traces essential the calculation may be missing.

For a full listing of all calculations and algorithms, please see Appendix B.

1) To Select a Calculation.
2) Determining Algorithms.
3) Protocols to Perform Calculations.

Figure 2: Data and AUX Channel Calculations



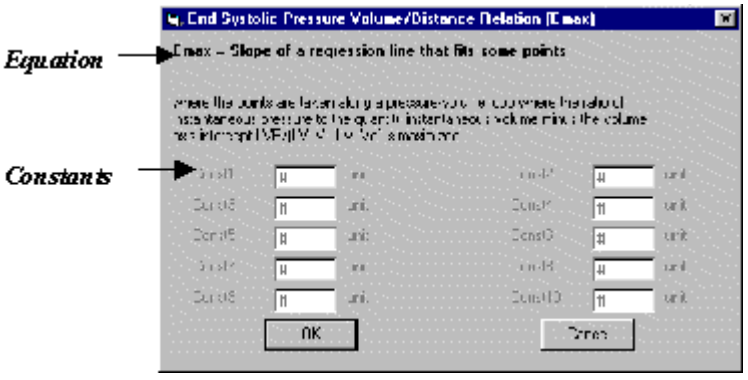
To Select a Calculation

1) Select from the *Category* drop menu the group containing the equation to be performed.
2) Select the specific calculation from the *Model* drop menu.
3) Select the trace type used, TRX, ADC or AUX radio dots from the *Source* menu in the *Trace and Time Offset in Calculation* box.
4) Select the trace used in the calculation.
5) Calculations dependant on ED and ES cycles, select the beginning and ending points in the *Calculation Period in a Heart Beat* drop menu
6) Once all fields are selected, shift the calculation to the *Parameters List* using the <<< button.

Viewing Algorithms

Calculations within CardioSOFT may be performed on any channel combination as specified. From the CardioSOFT interface, the algorithm may be viewed by clicking the *Equation* button while calculation is highlighted. Calculations using a value constant or variable may enter this value in the Equation window.

Equation Window Example



Protocols to Perform Calculations

Protocols to Perform Calculations

SonoVIEW supplies some default protocols and allows custom protocols to be made by the user. To reduce processing time, SonoVIEW and CardioSOFT allow the user to save numerous calculations to one file for later use in similar files.

Please select from:

1) To Create a New Protocol.
2) To Use a Default Protocol.
3) To Use a User Created Protocol.
4) Clearing a Protocol.

How to Create a Custom Protocol

In the *Parameters* listing field, up to 16 calculations may be entered. To reduce processing time, SonoVIEW and CardioSOFT allow the user to save numerous calculations to one file for later use in similar files. To create a custom protocol:

1) Select all calculations and transfer to *Parameters Listing* field (see To Select a Calculation).
2) Open the *File* menu in the upper left corner of the *Analysis* platform.
3) Select *Save Protocol As* and customize protocol location and name for later use.
4) Protocol files will be saved with a **.scp* extension.

How to Use a Default Protocol

CardioSOFT Pro comes equipped with four default protocols Tau, Emax, EDPVR and PRSW. To use:

1) Select *Default Protocol* from the *File* menu.
2) Choose calculation type to be performed.
3) All appropriate calculations will appear in *Listing Field*.
4) Press *Compute* button and view calculation on appropriate channels and spreadsheet.

How to Use a User Created Protocol

A user created protocol saves all calculations as defined by the user.

1) From the *Analysis* menu, select *File*.
2) Select *Open Protocol*.
3) In the *Open* window, select appropriate file folders to locate protocol with **.scp* extension.
4) Select the protocol file to be used and click *Open*. The Analysis window will open with calculations listed in the *Parameters Listing* fields.
5) If some calculations are not activated or are grayed, check the *Check to Calculate* radio dot and update field. Traces required for the calculation may not be available and must be calculated first.

Clearing a Protocol

Once calculations have been chosen they will continue to appear on the *Analysis* platform whenever opened. To remove all calculations:

1) From *Analysis* platform, open *File* drop list.
2) Select *Clear Protocol*.
3) All previous calculations will be removed along with the corresponding calculated data in the Data Zone. However all AUX channels will remain.

Saving Files in SonoVIEW

Saving Files in SonoVIEW

Data files may be saved in two formats in SonoVIEW:

1) Binary Format to be viewed in SonoVIEW.
2) ASCII Format. to be opened in a spreadsheet format such as Excel.

Saving in Binary File Format

File formats to be opened directly into SonoVIEW are *Old SonoLAB Binary (.**b), SonoLAB Binary data (.slb),* and *SonoSOFT Binary Data (.ssb).* These files will open to show Trace Zone, 2D-Zone and Data Zone. For a full listing and definition of these files please refer to Appendix A.

To save files in these formats:

1) Select *Save Binary* or *Save Binary As…* from the *File* drop menu
2) When *Save Binary* is chosen, SonoVIEW will default to save the current data file as an .ssb format with current file name and location.
3) When *Save Binary As…* is chosen the user may change the location or name of the file saved in .ssb format.

Saving in ASCII File Format

Saving in ASCII File Format

ASCII file formats include .ssa and .sca files. Select the type of information to be saved from:

1) Trace Zone ASCII Data (*.ssa files).
2) Data Zone ASCII Data (*.sca files).

Saving Trace ASCII Data

SonoVIEW allows numeric data samples for all traces or specific traces to be saved. These files are saved as .ssa data files and may be opened in a spreadsheet programs or word file.

To Save to ASCII format:

1) In the SonoVIEW menu, select *Save ASCII* from the *File* drop menu.
2) Select *Trace Zone.*
3) From the *Save Trace ASCII* window:
    a) Use the scroll bar labeled *Number of Samples* to set the number of data points to be exported.
    b) Use the scroll bar labeled *Escape Factor* to reduce file size by removing data samples at regular intervals if necessary. For example, a file to be exported has 4229 samples. If an escape factor of 1 is used, 2114 data points will be exported.
4) Select traces to export from:
    a) WYS (What You See) will export traces displayed in the Trace Window only.

b) Matrix allows the user to select crystal combinations and analog channels independently of what is seen on the display screen. Press the *Select* button to open *Matrix* and make selections.

5) Once traces selected, press *Save…* and select file name to be used.

6) File may now be opened in spreadsheet format.

Saving Data Zone ASCII Data

Numeric calculations in CardioSOFT and SonoVIEW may also be exported to ASCII format from the Data Zone. When saving, the active spreadsheet will be saved. Other spreadsheets must be saved separately.

To save the Data Zone:

1) Select spreadsheet to save in ASCII format

2) Select *Save ASCII* from the *File* menu

3) Select *Data Zone*.

4) The *Save As* window will appear with the file name and extension .sca. It is recommended to customize the file name if multiple Data Zone spreadsheets will be saved to prevent overwriting of files.

5) Press *Save* and the file may now be opened in spreadsheet format.

Printing Files from SonoVIEW

Printing Files from SonoVIEW

SonoVIEW allows the user to print the three display zones from the platform. The print feature is located in the *File* drop menu. When *Print* is selected, the user may select to print the Trace Zone or 2D-Zone. Data Zone must be printed from ASCII format.

1) Printing Trace Zone.

2) Printing 2D Zone.

3) Printing Data Zone.

4) Print Preview Options.

Printing the Trace Zone

To Print Trace Zone:

1) From the SonoVIEW platform *File* drop menu select *Print*.

2) Select *Trace Zone* and the Print Preview window will open.

3) Customize Printing Characteristics on Print Preview Platform.

4) Trace features such as size, paper source and alignment may be chosen from the *Options* menu

Printing the 2D-Zone

Graphical representation displayed in the SonoVIEW can be customized and printed directly.

1) Open the *File* drop menu on the SonoVIEW platform.

2) Select *2D Zone* from the *Print* option.

3) In the Print Preview window set printing characteristics.

4) Click *Print* to send the document to the printer.

Printing the Data Zone

In Version 3.2.1 the ability to print data zone is not possible. To print the data zone, save data to ASCII file and print from another program.

Print Preview Options

Print Preview Options

From the Print Preview platform the user may customize many aspects of the display page. Please select from the following options:

1) Options Menu.
2) Image Size Menu.
3) Margins Menu.
4) Orientation of Page.
5) Drag Positioning.

Options Menu

From the Print Preview menu the user may customize the size and positioning of the display to be printed.

Maintain Aspect Ratio: if one side of the display screen is rescaled, all other sides will also rescale to keep ration of length to height on the display screen.

Use Full Screen: an auto scale feature to resize view to utilize the full page.

Center on Page: will center the display on the page.

Margins Menu

From the Print Preview platform the user may customize the margins of the print page. All four margins may be set independently.

Image Size Menu

Using the Image Size options the user may customize the length and height of the display. Numerical settings may be typed in.

Resizing may also be performed using the mouse to drag sides of display. For more information please see Drag Positioning.

Orientation of Page

From the Print Preview platform the user may select the image to print as landscape or portrait. Previews will automatically update with changes in display region of the Print Preview platform.

Drag Positioning in Print Preview

from the Print Preview platform the user may reposition the display on the page and resize image in display region. To move image:

1) Position mouse over the display preview window.

2) Hold down the left mouse key and drag image to reposition on page.

To alter size:

1) Position mouse over edge of display image until shape of mouse turns to double arrow.
2) Hold down left mouse key and drag image.
3) If Maintain Image Ration radio dot is checked, corresponding sides will also rescale to maintain length vs. height ratio.

Trouble Shooting SonoSOFT

Trouble Shooting SonoSOFT

If a problem has incurred, please select from the following:

1) Cannot find binary files.
2) Calculations and Settings are not saved with files.
3) Get error message.
4) Calculated numbers are incorrect.

Cannot Find Binary Files

If the files cannot be found, please check the following:

1) Ensure the Type Drop menu located at the bottom of the Open window is set to appropriate extension. (see Opening Files)
2) Check folder name.
3) Have files been converted using Data Convert?
4) Go to My Computer on desktop.
5) Scroll through file folders to locate appropriate folder. (Default for saving in SonoLAB will save files to C:\SonoSOFT\Data or C:\SonoLAB in older systems.
6) If files are not present please stare Data Convert.
7) If files are present please verify location and return to #1.

Calculations and Settings Not Saved with Files

When a data files is closed in SonoVIEW, the display settings will also be saved. Files where no changes have been made will save to the .slb file format while filtered files or files with calculations will be saved to .ssb format.

If upon opening a file filtering, calculations or display properties are missing, please ensure the .ssb format of the file has been opened (SonoSOFT Open window will default to .slb

Error Message

Error Message

Please select from the following:

1) Error message is seen when opening file. Files will not open.
2) Error message when trying to Highlight (Trace Points are too condensed to Highlight).
3) Run Time Error.
4) Other Error Message.

Error Message Seen When Opening File

If an error message is encountered when opening a file, please perform the following.

1) Close the SonoSOFT platform is still open.
2) Open SonoSOFT platform.
3) Go to File, Open Data File.
4) When prompted to use latest template select No. (If unable to reach this stage please skip to #6)
5) If the file opens you are safe to continue as normal.
6) If file still does not open, go to My Computer from the desktop. Locate folder containing files.
7) Delete all .sst files from the file folder.
8) Attempt opening the file again. Again refuse to open using latest template.

If file will still not open, please look for updated versions of SonoSOFT from our web page at www.sonometrics.com. If no updates are available, please contact Sonometrics Technical Support team at support@sonometrics.com.

Highlighting Error Message

Over long files the resolution of the computer screen may not be high enough to differentiate between data samples. If the message "Trace Points are too condensed to Highlight, please zoom out on trace and attempt highlight again.

Run Time Error Message

If a Run Time Error occurs, please note the action performed before error message was seen and the program being run.

Check our website at www.sonometrics.com for any new releases of software which may have corrected the problem.

If no new software releases are available, please send a summary of the error to our support team at support@sonometrics.com.

Other Error Message

If an Error Message occurs, please note the action performed before error message was seen and the program being run.

Check our website at www.sonometrics.com for any new releases of software which may have corrected the problem.

If no new software releases are available, please send a summary of the error to our support team at support@sonometrics.com.

Calculated Values Not Correct

Calculated Values Not Correct

The following is a list of common questions regarding specific calculations:

1) Min and Max points are not correct.
2) Calculations using volume (i.e. EF, CO, SV) seem too low.
3) ES delineations are incorrect.

Min and Max Points Incorrect

Minimum and maximum determination is dependent on the delineation. To check delineation, please perform the following.

1) Please turn on delineation lines.
2) If all lines are highly condensed at beginning of file, please check trace used as delineator. This is commonly caused by noise in the trace.
3) If delineators seem to span multiple beats, please check sample number entered on the Analysis Platform. This number may need to be reevaluated.

Calculations Using Volume Incorrect

Depending on the type of experiment performed the placement of the crystals on the ventricle may greatly affect the calculation of volume.

The most common reason for volume values that are too low are placement through out the ventricle wall. If crystals have been placed on the epicardial surface, estimation for Wall Volume should be entered before calculating volume. This number may be entered from the Viewing Algorithms platform.

If wall volume will not have an effect, please check crystal pairs are named properly and axis have not been switched.

ES and Delineation Incorrect

The determination of ES may be different for each researcher. For this reason SonoVIEW allows the user to select the point of ES using one of multiple determinants. If the ES determination does not meet your needs please select another type of delineation utilizing different aspects of the LVP Trace. Please see Automatic Delineation for a further explanation.

SonoConvert

SonoConvert

SonoConvert is a Windows-based replacement for Convert, and is launched from CardioSOFT or SonoVIEW from the File menu as before. Here is a quick list of its features and benefits:

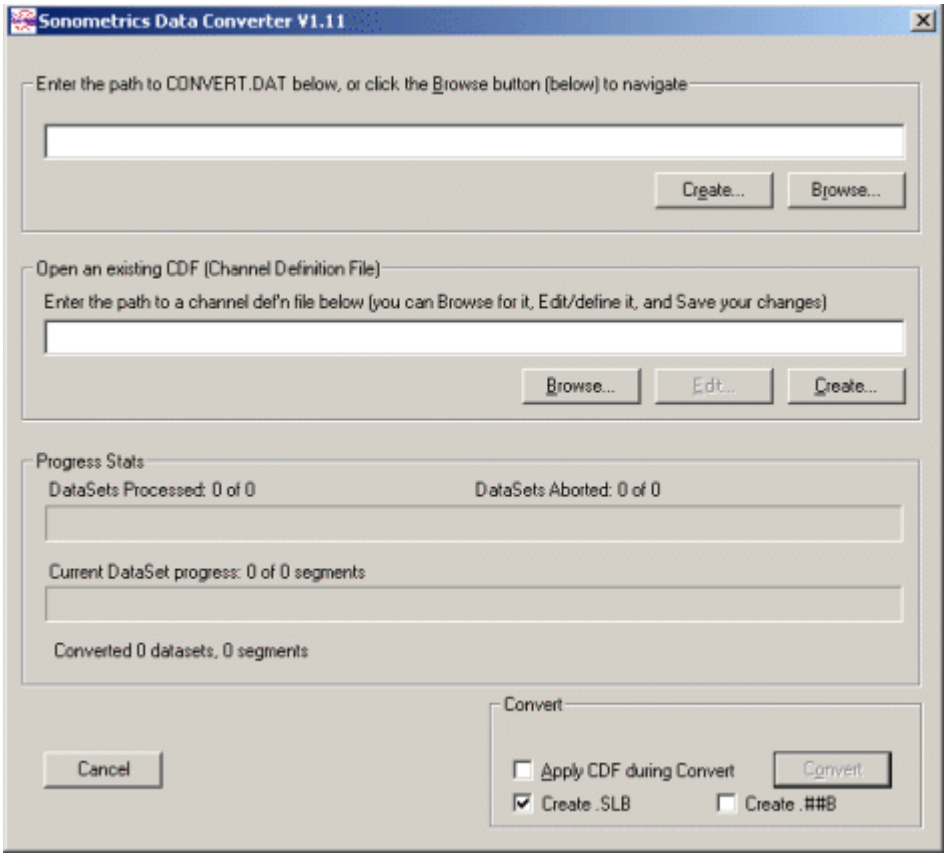
1. Windows-based application means no mode-switching to DOS
2. Five-fold increase in speed for large datasets
3. Directly produces .slb files from SonoLAB raw data files without producing intermediate .##b files (although that option does exist if required)
4. Offers the researcher the ability to create *Channel Definition Files* (.cdf) and apply these .cdf files against datasets during the convert process. This allows the user to specify names/units/crystal position/descriptions for channels in the datasets. The user can also specify that certain calculations (volume, derivative) be applied against specified channels during the convert process.
5. Saves the researcher time. Prior to SonoConvert, the researcher had to perform these tasks manually in CardioSOFT.

Can (re)create Convert.DAT file from SonoLAB raw data files: This process was a manual exercise if the Convert.DAT file was lost, corrupted, or if the raw data had to be reprocessed.

- Getting Started
- How CDF's are Applied
- Special Circumstances and Features
- Creating Convert.DAT files
- SonoConvert Cavets

Getting Started

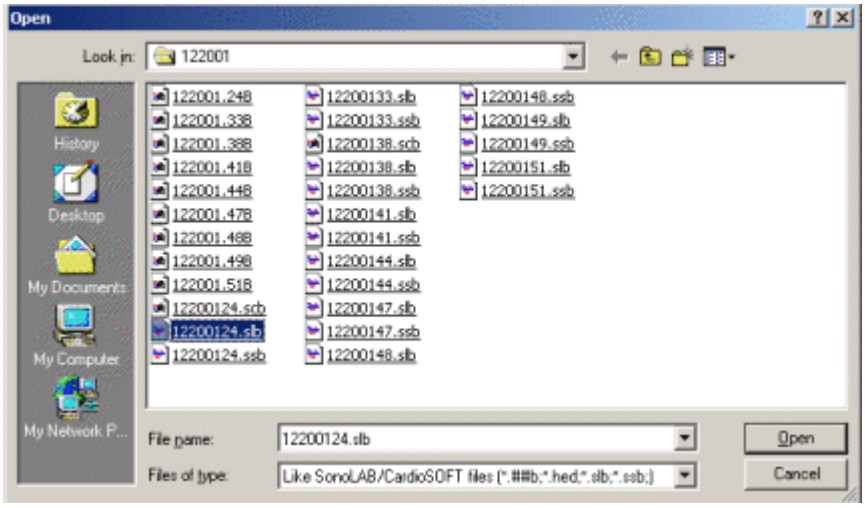
1. Launch SonoConvert from the **File èNew Data ConvertèConvert…** menu of SonoSOFT as before. You will see the main screen as shown:



   If a Convert.dat file was found, the **Browse** button in the upper right of the screen will be disabled. Otherwise, you may click the **Browse** button to navigate to the .dat file to convert.

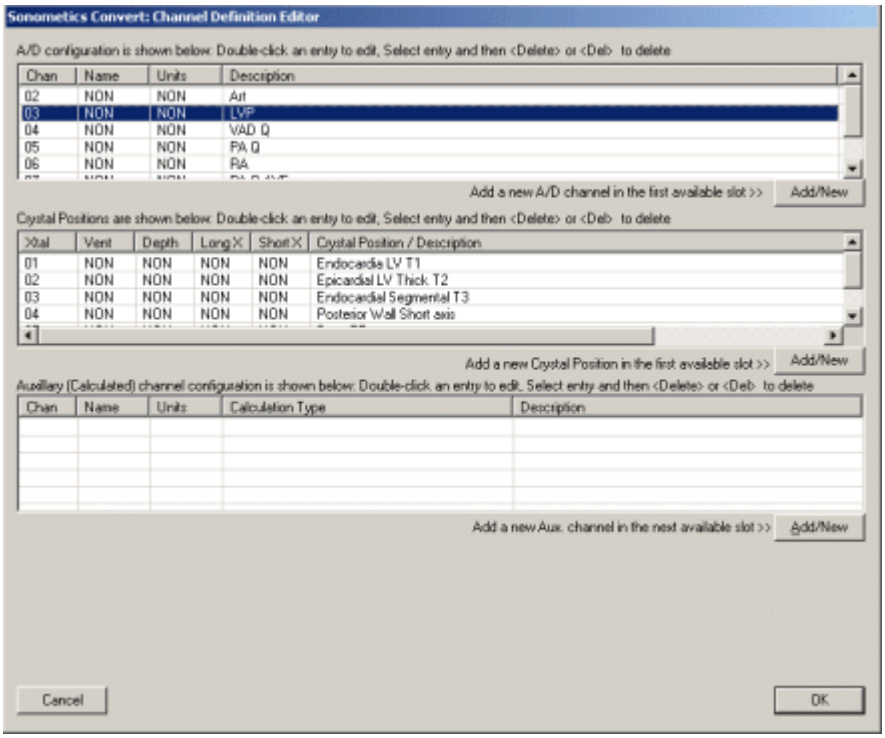
2. At this point, you *could* click the **Convert** button at the bottom right of the screen, and the program would perform as before, except the output is .slb files instead of the intermediary .##b files

3. The real power of SonoConvert is its ability to apply *Channel Definition Files* (.cdf) against all the data specified in a .dat file. You can either start with a new (blank) .cdf (click the Create button), or Browse and Edit. By Browsing, you can start with either an existing .cdf, or import the channel configuration from an existing .hed, .##b, or .slb file. Browsing is the quickest way to get underway, so that's the path we'll take here: Click the Browse button to reveal the following screen:

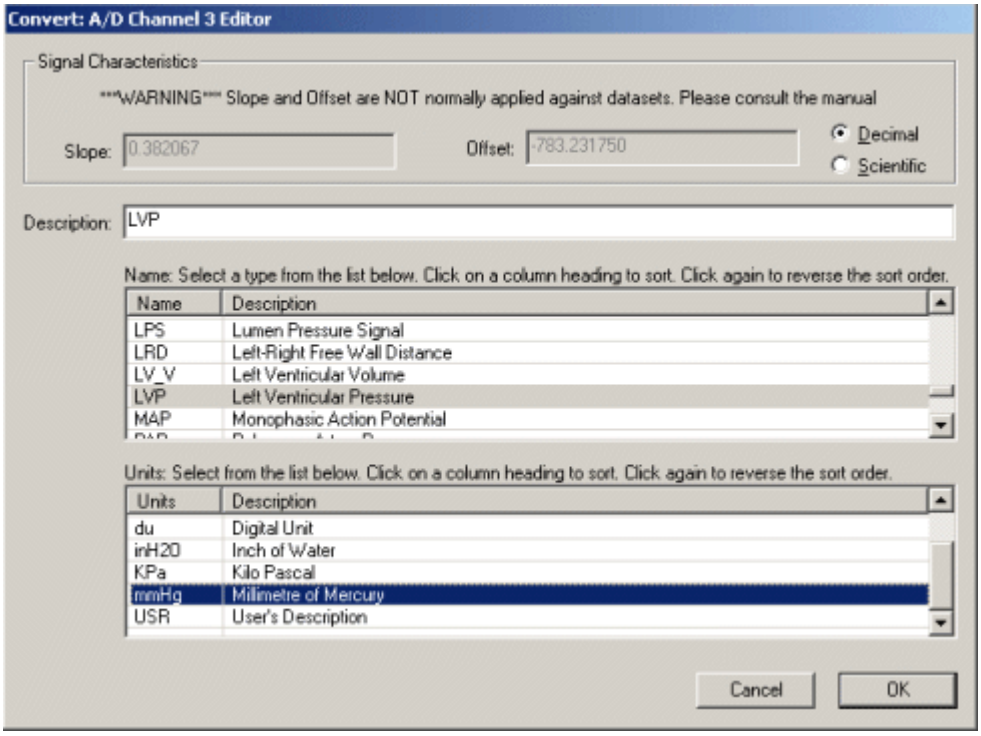


4. Here we can specify an existing .slb or .ssb file where we had named channels in the past. We could also select .##b or .hed files: All the user input in SonoLAB regarding channel configuration, naming, units, etcetera, will be imported into the Channel Definition Editor. In this example, we'll select an .slb file.

5. Click the **Edit** button on the main screen to reveal the Channel Definition Editor:

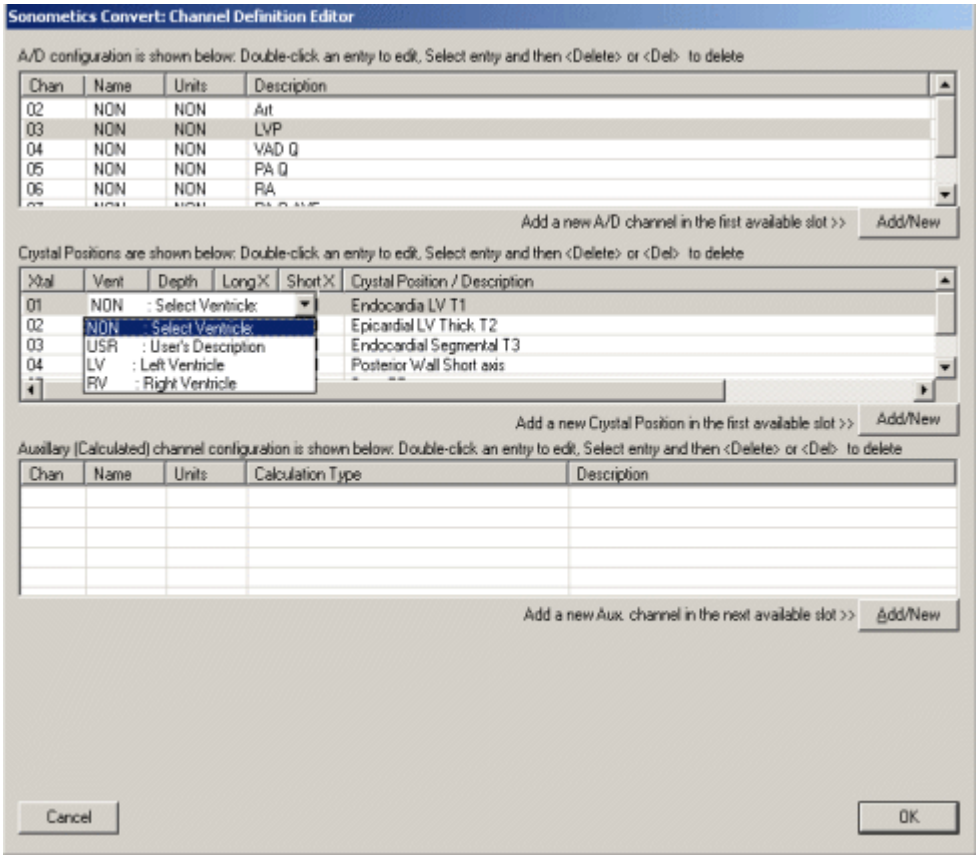


6. Let us edit A/D channel 03 – Double click on channel 03 (it's highlighted above) to reveal the A/D Channel Editor:

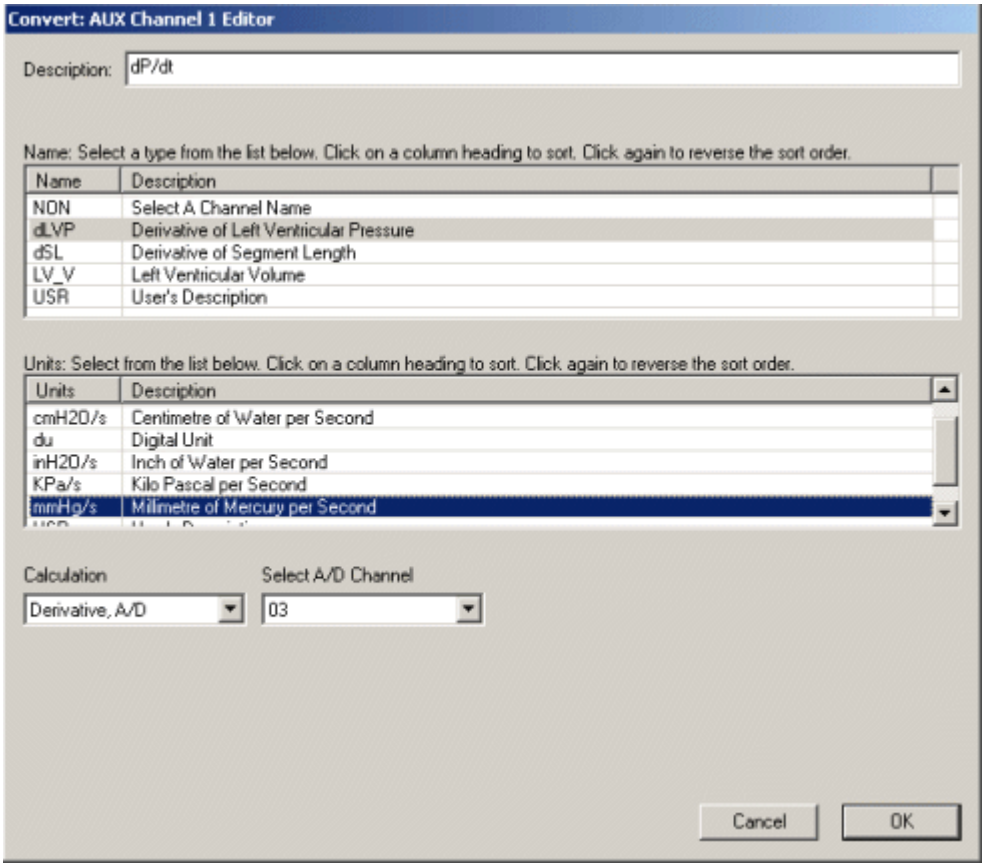


The title bar indicates the A/D channel being edited. The screen is populated with the existing values. The list in the Units list reflects valid Units for the selected measurement in the Names list box, thus you would select a Name first (by clicking on it), and then a Unit. In this case we've assigned a measurement name of LVP with units of mmHg. Once you're done, clicking **OK** will save your changes to the Channel Definition Editor whereas clicking **Cancel** will discard them. From the main screen (shown in point 5 above), you can also create a new channel with default setting by clicking the **Add/New** button. You would then double-click the new entry to edit it just like the example above.

7. Crystal Positions are edited slightly differently. Double-clicking on the first "NON" (under the heading Vent for Ventricle) for crystal 01 reveals a drop-down list of available choices. The same applies for Depth, LongX (long axis), and ShortX. Finally, double-clicking on the Crystal Position/Description field allows directing editing of that field.

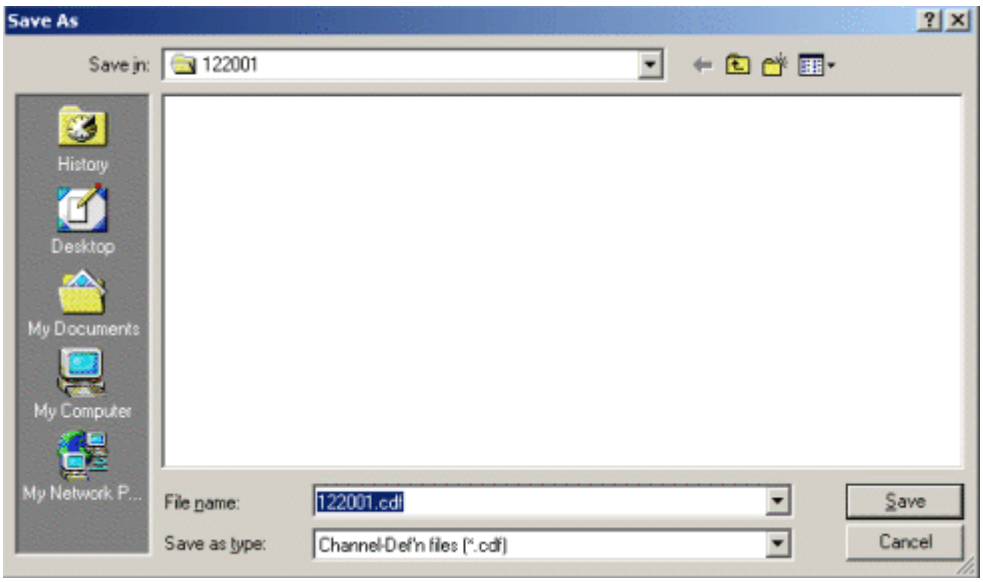


8. Clicking on the **Add/New** button beneath the Auxiliary (calculated) Channel list box allows you to specify calculations to be done during the convert process, and thus incorporated directly into the resulting .slb file:



In this example, the derivative of A/D channel 03 will be computed during the Convert process. The dropdown lists will change in number and contents depending upon the calculation selected in the Name list. Likewise so will the Units list contents. Click OK to save your changes.

9. When you're done with all your changes, click the OK button on the Channel Definition Editor. You will be prompted to save your Channel Definition File:



You can change the file name to whatever you like. The saved file will always have a .cdf extension. Be aware that if you do supply an extension that the last .xxx will be replaced with .cdf. For example:
MyFile becomes MyFile.cdf
MyFile.abc becomes MyFile.cdf
MyFile.abc.123 becomes MyFile.abc.cdf

10. Next to the Convert button (on the main screen) you'll see an "Apply CDF during Convert" check box. Check the box and click the Convert button: Your done!

How CDF's are Applied

The rules governing how a .cdf is applied against datasets is relatively straightforward: For each enabled channel in a dataset, if there is a corresponding channel in a .cdf, it is applied. This implies that you can create a .cdf naming 32 crystal channels, 16 A/D channels, and 32 Aux channels: Only those that also exist in the dataset will be affected. Note that the *Slope* and *Offset* fields **are not normally applied** to a dataset except under **special circumstances** (see below) since doing that would normally be improper.

Special Circumstances and Features

Normally only .slb files are produced during a convert process, however you can also produce .##b files which are useful for a data capture play-back through SonoLAB; simply check the **Create .##B** checkbox on the main screen. You can create only .slb files, only .##b files, or both concurrently.

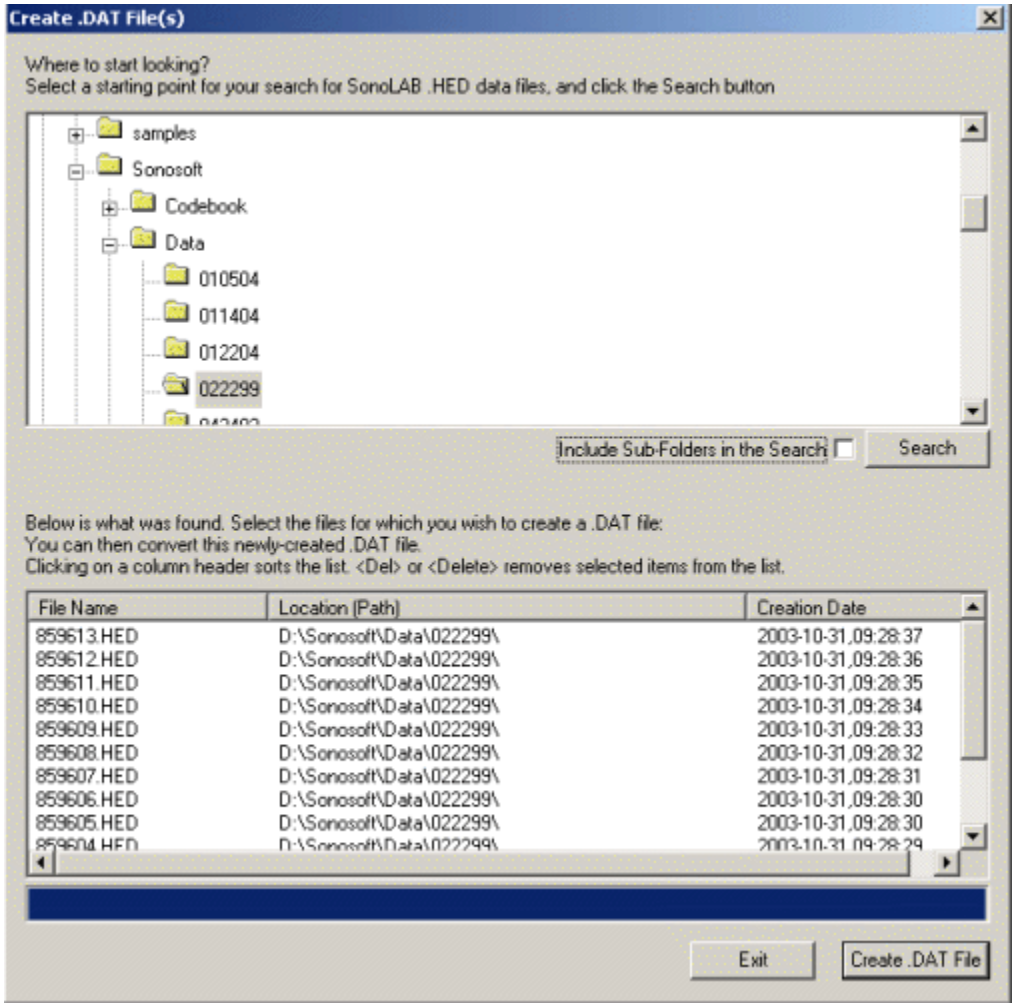
Additional SonoConvert features may be enabled under special circumstances: Please contact Tech Support for details as to how this may be done. These facilities are invisible or grayed-out until enabled.

1. The *Slope* and *Offset* values in a .cdf can be applied to a dataset on a channel-by-channel basis. Obviously this feature must be used with great caution, and only under special circumstances such as when it can be determined that the original values given to SonoLAB were in error and the correct values are known.
2. SonoConvert also features an *Annotations* editor that can modify the annotations entered into SonoLAB for an experiment. SonoConvert will only modify empty and default annotation strings with the ones entered into the .cdf via the Annotations Editor. Nonetheless, this feature must be used with caution.
3. SonoConvert also has an "Auto Run" feature, which allows it to run without user input, automatically applying a specified .cdf against a specified dataset. The main screen will appear only during processing and then silently close two seconds after the datasets are processed.

Creating Convert.DAT files

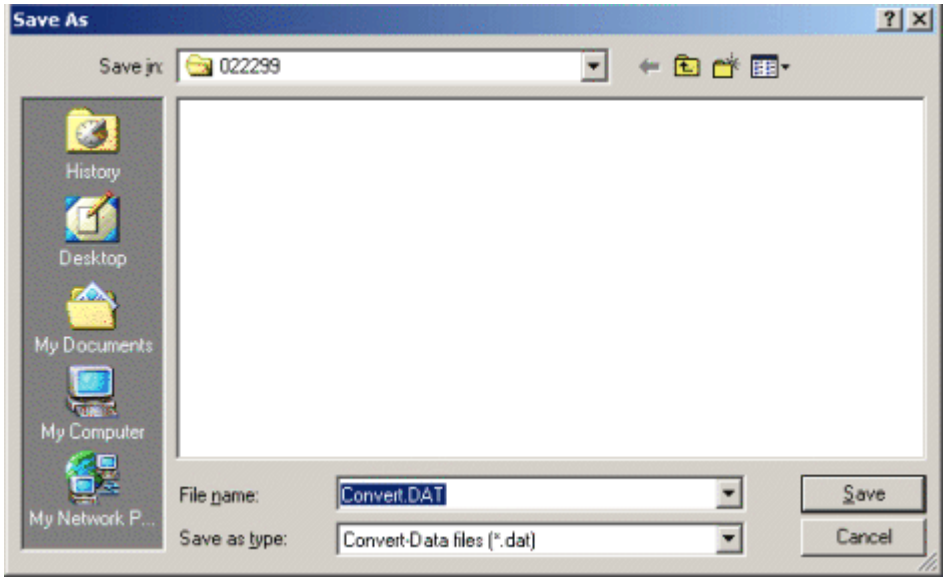
In some circumstances you may find yourself with SonoLAB raw data but no Convert.DAT file: Perhaps the data had been previously converted, or the raw data files were moved to another computer but the Convert.DAT file was left behind. SonoConvert allows you to create a Convert.DAT file for a given set of raw data files: This created Convert.DAT file can be subsequently used to convert the data.

From the main screen, (please refer to **Getting Started**, step 1), click on the **Create** button: The following screen will appear:



The top half of the screen allows you to navigate to the directory (folder) of interest in a fashion similar to Windows Explorer. Once you have selected a folder, clicking the **Search** button lists all the eligible raw data files. The search function will also examine sub-folders if the **Include Sub-Folders in the Search** item is checked.

Simply select the files of interest using the standard Windows methods, and click the **Create .DAT File** button. (As a shortcut, clicking the button will pop up a message box asking you if you wish to convert all the files.) Next, you will be prompted to save the file:



SonoConvert saves to the name Convert.DAT in the directory containing the raw datafiles by default, however you are free the change this as you see fit. Once saved, the main screen reappears with the .DAT filename automatically filled in for your convenience. At this point, you can specify (or create or edit) a Channel Definition File and proceed with the Convert process.

SonoConvert Cavets

Care must be taken when applying a CDF against raw data to insure that the channel definitions do in fact match the channels in the raw data capture. Unexpected results occur if a CDF is applied against datasets with different channel assignments during experimental runs. For instance, one of the experimental runs may have recorded LVP on AD channel 05 whereas all the other datasets used channel 04. In this situation, a dP/dt calculation for channel 04 (as specified in a CDF) would produce meaningless results for the dataset that recorded LVP on channel 05.

Batch Processing

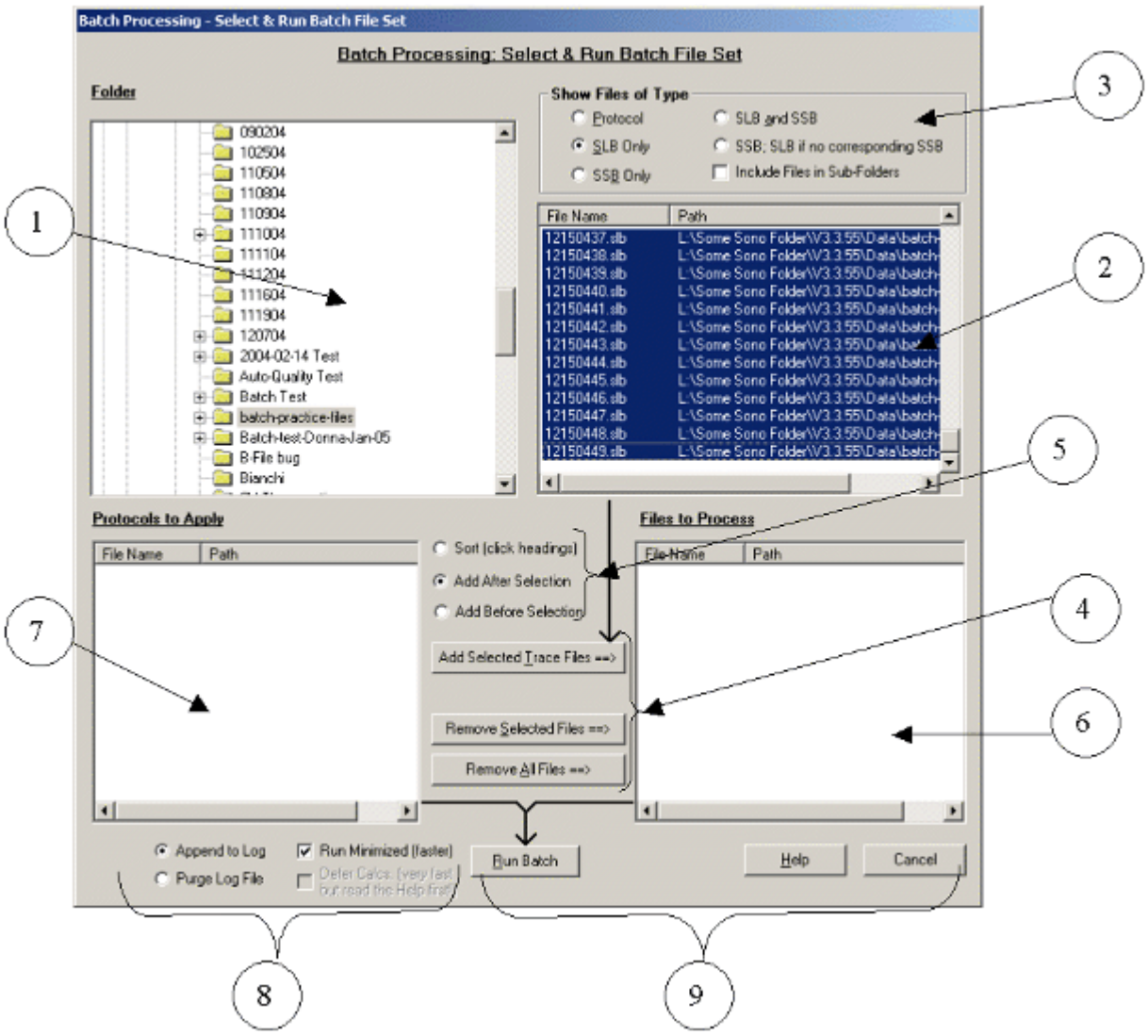
Overview

Frequently the same analysis procedures must be applied across many .slb files. The Batch Processing facility allows you to create a “template” of general display layout (number and type of traces to display, 2D plot characteristics, etc.) and set of protocols (calculations) to apply against a large number of .slb files, thus relieving the tedium and error-prone process of doing this manually.

- Getting Started
- Principal of Operations and Deferred Calculations

Getting Started

The first step is one that you are already familiar with: Open the first .slb in the “batch” series, and do the operations you require to that file. For instance, you may wish to display only a subset of all the available traces, set the trace precisions, and/or define that calculations you want. Once you have the work done to your satisfaction, click on the **Batch…** menu item, and the following screen will appear. (Note that you must have the appropriate license key to do this. New purchasers of CardioSOFT will already have a batch-processing license. Contact Sonometrics if you are upgrading from a version of CardioSOFT/SonoVIEW prior to V3.4.1)



Explanations of the circled areas in the above screen-shot follow:

1. This is the file-folder view. The initial directory (folder) is the one that contains the file that CardioSOFT/SonoVIEW displayed when you clicked the **Batch…** menu item, but you can another folder if you wish.
2. This is the file view of the files in the folder you selected in (1). The *type* of files shown depends on what you select in (3)
3. Here you specify which type of files will be shown in (2). The default selection is **SLB only**, meaning that (2) will only show .slb files of all the files in the folder you selected in (1). Other choices are **SSB only** (self explanatory), **SLB and SSB** (show both types), and finally **SSB; SLB if no corresponding SLB**. This last choice will show SLB files only if there is on corresponding SSB, otherwise SSB files will take precedence. You would use this option if you create SSB files from only some of the SLB files; for instance, you might manually filter some of the SLB files, and thus only wish to run calculations on the filtered data. The **Protocol** choice display protocol files (.SCP files). Finally, the **Include Files in Sub-Folders** check box consider files that exist not only the currently selected folder in (1), but also in any sub-folders of (1).
4. These buttons determine what to do with the selected files in (2). The buttons have an arrow associated with the button text: If protocol files are chosen in (3), then the arrows point toward (7), else they point toward (6). The **Add Selected Files** button copies the selected files in (2) to (6) or (7), depending on the direction of the arrow. Note that all files in (2) are selected by default, however you are free to select a subset using standard Windows files selection

techniques. How those files get added depends on the choice made in (5). Finally ,the **Remove Selected Files** and **Remove** All Files buttons remove files from (6) or (7).

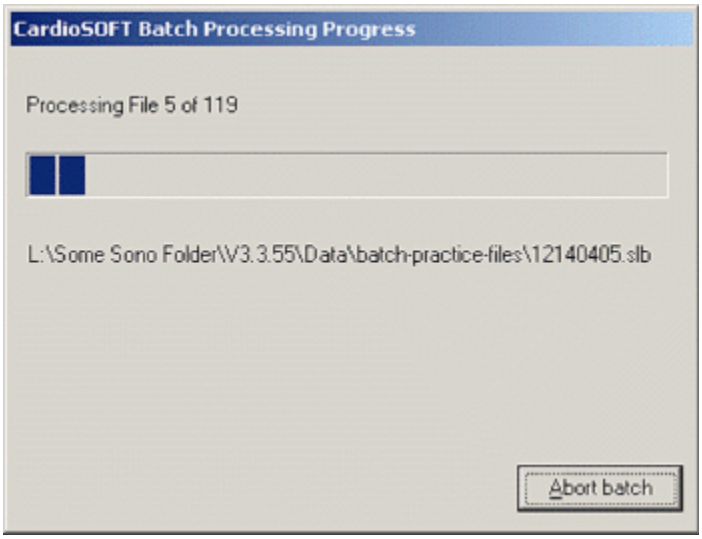
5. The **Sort (click headings)** option allows you to sort the files in (2), (6), and (7). Files can be sorted in ascending or descending name order by clicking on the file list headings (successive clicks on a heading toggles between ascending and descending order). You can also sort by path (folder) name. The file order controles processing order: This has no real consequence for files in (6), however the protocol files in (7) could matter if some protocols require traces produced by other protocols!

   The **Add After Selection** and **Add Before Selection** allows you to add files in (2) relative to the current selection in (6) or (7).
6. This list contains the files that will be processed.
7. This list contains the external protocol files that will be run against the list in (6). If no files appear here, then the protocol that gets applied is whatever you may have defined before clicking the **Batch…** menu item. Note: This results in the fastest batch processing times as no external protocol files need to be opened and loaded.
8. A log file is always produces when a batch is run. **Append to Log** adds to an existing log files whereas **Purge Log File** will overwrite an existing log file. The name of the log file is *Batch.xxx.log*. where *xxx* corresponds to the file displayed in CardioSOFT/SonoVIEW when the **Batch…** menu item was clicked.

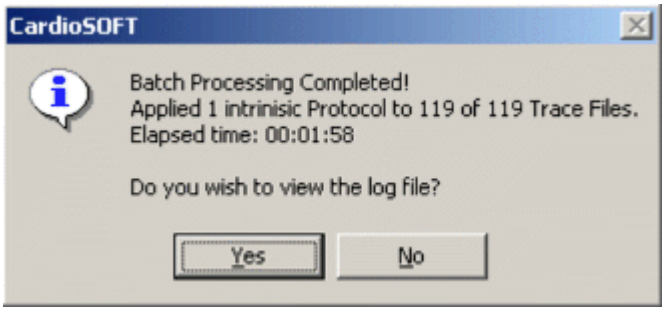
   The **Run Minimized** option is checked by default and prevents the CardioSOFT Anaylsis screen from displaying. Since the setup of the Analysis page requires time, running minimized speeds batch processing.

   The **Defer Calcs** option is disabled by default and can only be enabled from the Help screen. Deferred calculations run at very high speed, however there are some important caveats that will be explained later.
9. The **Help** and **Cancel** buttons are self-explanatory. The **Run Batch** button sets the batch processing in motion. The trace files are processed in the order they appear in (6). If any external protocol files are shown in (7), they are applied in the order they appear.

   A progress screen appears once the batch starts running; the **Abort** button stops the currently running batch.



A summary screen appears upon batch completion and gives you the option to view the log file. The last processed file will be displayed in CardioSOFT/SonoVIEW.



Principal of Operations and Deferred Calculations

Principal of Operations and Deferred Calculations

This section explains what goes on behind the scenes: It is not necessary to memorize what goes on, however having a good understanding of "what's under the hood" will help you make better use of batch processing and the caveats associated with deferred calculations. Topics included in this section are:

- CardioSOFT File Types
- Intrinsic Protocol
- External Protocol Files
- Deferred Calculations

CardioSOFT File Types

Here is a quick description of the SonoSOFT file extension types:

.SLB	**S**ono**L**AB **B**inary: SonoConvert output from SonoLAB .HED and .##B files as input.
.SSB	**S**ono**S**OFT **B**inary: Typically a .SLB file where the trace data has been modified. For example, filtering .SLB trace data.
.SST	**S**ono**S**OFT **T**emplate: Specified display layout data for the .SLB or .SSB. Specified the Trace Matrix, number of displayed traces (of each different type), 2D Graph, delineator availability.
.SCP	Protocol file. Defines the calculations performed on the trace data. .SCP files define "generic" protocols. For example, the PRSW.scp found in the SonoSOFT\Protocols directory. .SCP files are referred to as external protocols.
.SCT	Protocol file for the .SLB or .SSB file. If you were to open 1234.SLB and load the PRSW.scp protocol, and then saved your work, you would have a 1234.SCT file. The .SCT file saves the protocol that was in effect when you saved your work. This is referred to as an intrinsic protocol since it can be considered to be part of the particular .SLB/.SSB file in question.
.SCB	CardioSOFT Binary. This file saves the end result of performing calculations on the .SLB or .SSB file. For instance, suppose you run a series of protocols, calculate delineators, etc. The .SCT file will contain the last protocol, and the .SCB file will contain the aggregate result of all modifications to the traces: Any newly created traces, deleted traces, complex and cyclic parameters, 2D graph, etc. The next time you open the .SLB/.SSB file, it is the .SCB file that gets displayed.

Intrinsic Protocol

Suppose you have a file (1.slb) set up just the way you wish: The type of delineators specified, the number of each type of trace, calculations specified, etc. Further suppose that you wish to apply this same setup to files 2.slb and 3.slb; here is what happens when you run the batch:

1. The files (all the ones that exist) 1.sst, 1.scp, and 2.sct are copied to 2.sst, 3.sst, 2.scp, 3.scp, 2.sct, 3.sct
2. File 2.slb is opened. The analysis page is opened and the protocol there is run
3. File 2.slb is closed
4. Steps 2 and 3 are done with file 3.slb

External Protocol Files

This time, we have the same set of .slb files, however we want to run two protocols (A.scp and B.scp) in succession against those files. As before, tweak 1.slb layout. Run A.scp and B.scp. Make any changes to the layout. Now when you run the batch…

1. The files (all the ones that exist) 1.sst, 1.scp, and 2.sct are copied to 2.sst, 3.sst, 2.scp, 3.scp, 2.sct, 3.sct
2. File 2.slb is opened
3. The analysis page is opened and cleared
4. Protocol A.scp is loaded (replacing whatever was there) and run
5. Protocol B.scp is loaded (replacing whatever was there) and run
6. File 2.slb is closed
7. Steps 2 – 5 are repeated for file 3.slb

Once again, checking the **Run Minimized** checkbox saves more time since the analysis page does not have to be painted on the screen.

Deferred Calculations

This is by far the fastest method of batching. There is an important prerequisite, however: Deferred Calculation batching *can only be used with intrinsic protocols* (i.e. No external protocol files).

Normal batch processing with an intrinsic protocol takes (on average) two to three seconds per file: Deferred Calculations take (on average) 0.1 to 0.2 seconds per file! For large batch sets, this means you can start analyzing the data almost immediately compared with normal batch processing.

Deferred Calculations achieves this speedup using some slight-of-hand. This mode of processing simply clones (copies) the .sst, .scp. .sct files of the trace file that is loaded in CardioSOFT to the remaining files in the batch set. The timestamps of these files is manipulated so that when you subsequently open one of those files for analysis, CardioSOFT can determine that the calculations have not yet been run, and so runs them in the background. In otherwords, the calculation time that is performed by the normal processing mode is deferred until the file is opened: The time to open one of these files is increased by (on average) two seconds longer the first time *only*. The advantage to using deferred calculations is that you can start analyzing your data almost immediately.

SonoVOL

SonoVOL

SonoVOL is used to measure the surface area of a structure and the volume enclosed between crystals. In cardiac applications, SonoVOL directly measures cardiac volume, wall surface area and shape of the entire heart and left ventricle.

SonoVOL calculates cardiac volume and shape using the convex hull approach based on crystal 3D coordinate data generated by SonoXYZ software.

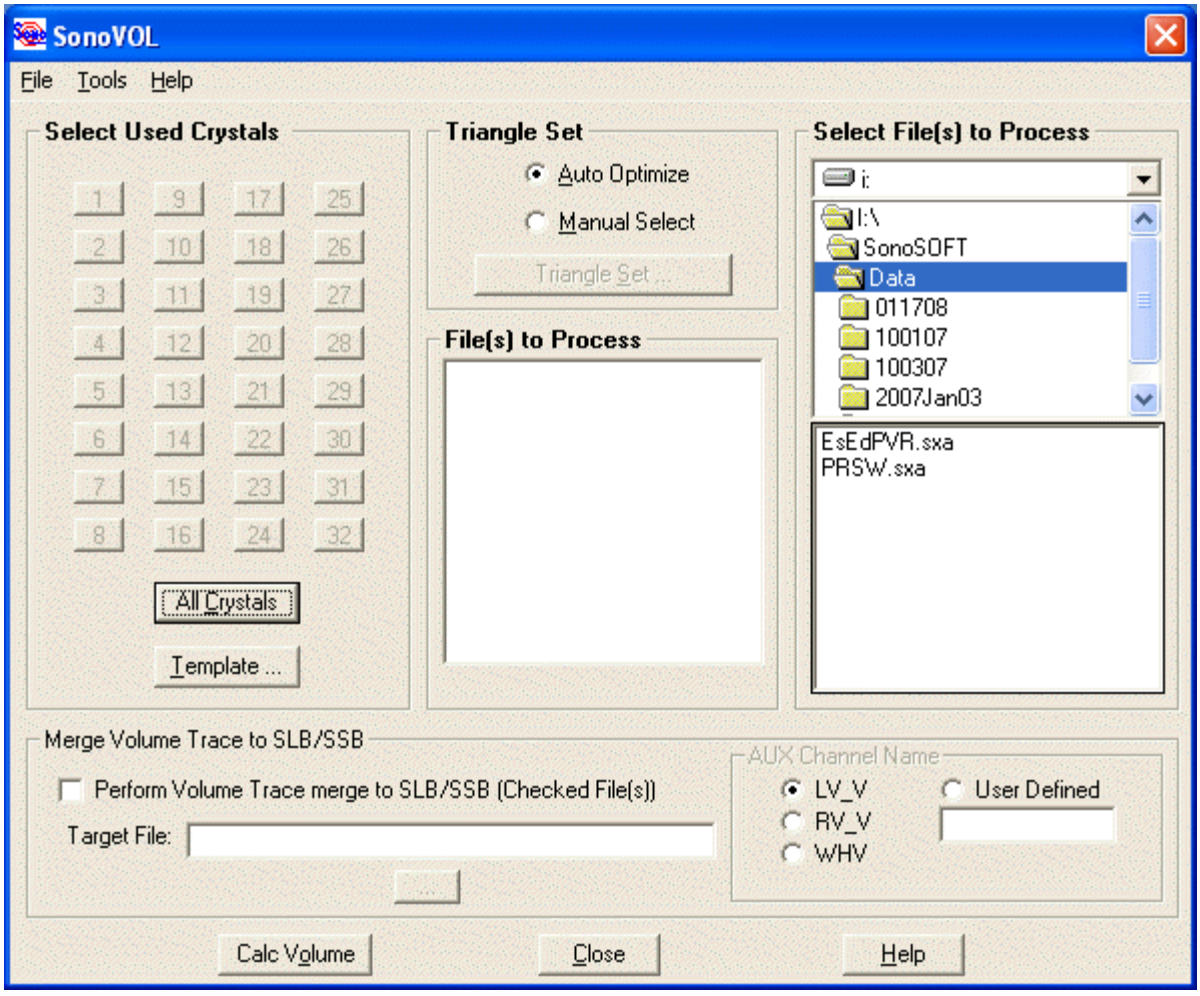
1) Using SonoVOL.

2) Files Generated.

3) Version History

Using SonoVOL

SonoVOL software is designed with a graphic user interface on Microsoft Windows:



A typical operational sequence might be as follows:

1) Run SonoVOL application from SonoVIEW *Analysis* menu.

2) Select the 3D coordinate file(s) (*.xyz or *.sxa) to process.

3) Check specific crystal numbers or *All Crystals* button to identify the crystals used to calculate the volume and surface area, or click the *Template* ... button to select an existing crystal number configuration file (*.svt).

4) By default, SonoVOL selects a triangle set with optimized maximum number from all time points automatically.

5) A data file that has been processed with the *Auto Optimize* option will generate a fixed triangle set file (*.svf). If you wish to use this same fixed triangle set with another data file, select the desired data file, check the *Manual Select* option, click the *Triangle Set* ... button and then select the desired existing fixed triangle set file (*.svf) prior to activating the OK button.

6) If less than 3 crystals are checked, no volume or surface area can be calculated. If only 3 crystals are checked, volume is zero and surface area is the single face area of a triangle plane. If more than 3 crystals are checked, the convex hull volume and surface area will be calculated.

7) If it is desired to merge the calculated volume information back into the originating SLB or SSB file, follow the procedures described in Version 3.0.5.

Additional usage information can be found in Version 3.0.5 and Version 3.0.1.

Files Generated

SonoVOL generates four files with the extensions: SVA, SVE, SVF and SVV. See Version 3.0.1 for the circumstances under which each file is generated. A descriptions of each file format follows:

The SVA file contains the following information (same as SVV, see note below):

- SVA file header information
- for each time point in the SXA file:
- the time
- the number of facets
- the total area of the facets
- the volume defined by the facets
- for each facet: the vertices and area of the facet

All information for one time point is stored on a single line. For configurations containing a large number of vertices, the line length can become quite large (each line consists of approximately 55 to 60 bytes of time, number of facets, area and volume data; plus 25 to 30 bytes for each facet list and area; therefore, 65 to 70 facets will generate a line length of about 2048 bytes or more).

NOTE: The SVA and SVV files have the same format. The SVA file is generated if the user has activated the Manual Select option and specified a SVF file. If the Auto Optimize button is active, the resulting calculation will generate an SVV file.

The SVE file contains the list of all possible edges on the convex hull as determined from all the facets used during the processing of all time points in the SXA file. The format of the edge data within the SVE file is several lines containing the word "Edge" followed by the two vertex numbers associated with the edge. This format permits the user the ability to copy and paste the edge list information directly from the SVE file into the configuration file used by the View3D application.

The SVF file contains information on all of the facets used in the processing of the SXA file. The format of the facet data is as follows:

- SVF file header information
- the number of facets on this line (this version only presents one per line)
- the three vertices associated with the facet
- the number of times the facet appeared on the convex hull during the processing of the SXA file.

The previous version reported the facet information on one line and did not include the usage frequency.

The SVV file contains the following convex hull information (same as SVA, see note above):

- SVV file header information
- for each time point in the SXA file
- the time
- the number of facets on the convex hull
- the area of the convex hull
- the volume of the convex hull
- for each facet on the convex hull: the vertices and area of the facet

All information for one time point is stored on a single line. For configurations containing a large number of vertices, the line length can become quite large (see SVA file information). Note, that the number of facets on the convex hull may vary between time points.

SonoVOL History

Version History

Additional information on SonoVOL versions can be found in:

- Version 3.0.5
- Version 3.0.1
- Prior to Version 3.0.1

Version 3.0.5

Version 3.0.5 of SonoVOL provides the ability to merge the calculated volume trace back into the original Sonometrics binary file (.SLB or .SSB) as an auxiliary (AUX) channel. By default this capability is turned off. The suggested procedure for setting up the merge capabilities is as follows:

1) Prior to selecting the files to be processed, make sure that the “Perform Volume Trace merge to SLB/SSB (Checked File(s))” check box is checked (c.f. Using SonoVOL).

2) Select the File(s) to process.

3) By default, in the “File(s) to Process” list, the check box associated with each file is checked. Each file which has its’ check box checked will have the associated volume trace merged back into its’ targeted SLB or SSB file provided that the check box in step 1) remains checked and the associated Target File exists. If the check box referenced in step 1) is unchecked, the individual file check boxes have no significance.

   The default behaviour for determining the target files for each File to Process file is to look in the same directory for a file with the same name as the sxa/xyz file but with an extension of .SSB. If an .SSB file is not found then an .SLB is sought for. If an .SLB is not found, the target file for that particular File to Process is left blank. The user is able to modify or browse for an appropriate target file if the step 1) check box is checked.

   In the event that there are several File(s) to Process, follow these steps to modify the Target File for a particular File to Process. Highlight the appropriate File to Process. The associated Target File specification will appear in the Target File edit box. The user can either edit the file specification directly or use the browse (…) button to search for an appropriate file.

   Similarly, the user is able to select the Name associated with each Merged trace. As in the previous paragraph, the Name settings correspond to the highlighted item in the File(s) to Process list box. By default, the name of the merged volume trace will be “LV_V”. Other options include “RV_V”, “WHV” and a user-defined name (maximum of 8 characters). The units for the merged trace will be “ml”.

4) Once the appropriate target files and file check boxes have been configured, activate the “Calc Volume” button to perform the merge operation.

   This operation will match the time points within the SVA/SVV and the SLB/SSB. Any time points that are not in the SVA/SVV but are in the SLB/SSB will be filled with the average value of the volume trace. It is assumed that the SVA/SVV file was derived from the SLB/SSB file being merged to and, therefore, sample time variances should not occur. The merged volume trace will be the last AUX channel in the SLB/SSB file. If prior to the merge operation the SLB/SSB has an auxiliary channel AU32, the merge operation will fail. The merge operation will always attempt to append the data into the next available AUX channel..

NOTE: It is also possible to merge the volume traces by utilizing the “Tools”, “Merge Volume Trace” from the SonoVOL menus. The activation of this menu item will bring up a dialog, which will require the specification of the source SVA/SVV file, the target SLB/SSB file and the Aux channel name. Once the required information has been entered, activating the “Merge” button will perform the merge of the volume data into the targeted SLB/SSB file.

Version 3.0.1

This version of SonoVOL utilizes a Convex Hull algorithm based on the "Incremental Algorithm" described in Chapter 4 of "Computational Geometry in C", second edition. The book is authored by Joseph O'Rourke and was published by Cambridge University Press in 1998 (ISBN: 0-521-64976-5). This algorithm is capable of handling configurations in which some of the vertices (crystals) on the Convex Hull are found to be collinear and/or coplanar. The previous algorithm used in SonoVOL was incapable of handling these types of degeneracies.

The user interface remains the same from the previous version of SonoVOL. There are two primary calculation paths:

1. In the first calculation path, the algorithm determines the Convex Hull at each time point in the SXA file. The SXA file contains the x, y, z coordinates of the crystals as determined and generated by SonoXYZ. The user selects an SXA file to process, using either "All Crystals" or user specified crystals and the "Auto Optimize"d Triangle Sets (typically refereed to as facets or faces, each facet has three crystals or vertices, as well as three edges, each edge being defined as the line between two crystals or vertices). Activating the "Ok" button will cause the application to generate text files with the extensions ".SVV", ".SVF" and ".SVE".

2. The secondary calculation path allows the user to specify which facets are to be used in the calculation of the area and volume. It is the user's responsibility to make sure that the choice of facets defined will provide meaningful results. SonoVOL simply calculates the area and volume defined by the user facets. The secondary calculation path does not attempt to make sure that the user selected facets form a proper convex hull. The facet file (.SVF) generated by the first calculation path can be used as input to the second path. To follow the second calculation path the user is required to select the "Manual Select" radio button in the "Triangle Set" and choose the proper facet file by depressing the "Triangle Set …" button. Activating the "Ok" button will result in the generation of text files with the extensions ".SVA" and ".SVE".

Prior to Version 3.0.1

SonoVOL generated five files that have the same path and file name as 3D coordinate file but different file extensions:

.sva - ASCII file of volume and surface area by both varying triangle set and fixed triangle set.

.svv - ASCII file of triangle facets by varying triangle set.

.svf - ASCII file of triangle facets by fixed triangle set.

.svc - ASCII file of coplanar crystals. (This file does not exist when using crystal coordinates calculated by SonoXYZ 2.0 and later).

.svt - Binary file of crystal configuration template.

SonoVOL applies the convex hull algorithm using the outermost crystals at each time point to generate a convex hull that has the largest volume. The index of triangle facets may vary from time to time. The .sva file has the results computed from this algorithm.

SonoVOL selects the triangle set in which the facets occur most frequently and the most crystals are involved as a fixed triangle set. The volume and surface area are computed with the fixed triangle set through all time points. The .sva file has results computed from fixed triangle set, as well as each triangle area of the fixed triangle set.

All result files are in ASCII format. The user can make further calculation or generate a graphic report with spreadsheet software.

View 3D

View 3D

There are now two versions of View3D. One is the previous DOS based version. The second is a windows based version. More information about each version can be found at:

- DOS View3D

- Windows View3D

DOS View3D

DOS View3D

The View program is designed to display a 3-D data file as an animated movie loop. The mouse can be used to rotate the display so that the data can be viewed from any angle as well as magnifying or reducing the display size. The speed of the playback can also be altered.

Please select from:

1) Quick Key Reference in View 3D.

2) Customizing 3D View Screen.

Quick Key Reference in View 3D

The view program uses the following keyboard controls. During operation, press the following keys to perform these functions:

(Q) Changes the X-Y rotation angle by one degree (positive)

(A) Changes the X-Y rotation angle by one degree (negative)

(W) Changes the Y-Z rotation angle by one degree (positive)

(S) Changes the Y-Z rotation angle by one degree (negative)

(E) Increments (by one degree) constant rotation in the X-Y plane

(D) Decrements (by one degree) constant rotation in the X-Y plane

(R) Increments (by one degree) constant rotation in the Y-Z plane

(F) Decrements (by one degree) constant rotation in the Y-Z plane

(+) Increases the playback speed

(-) Decreases the playback speed

(Z) Select another file to view

(space) Freezes the playback

Customizing 3D View Display Screen

Customizing 3D View Display Screen

The following is a description of the accessory files that the View.exe program looks for when it is executed. There are 7 files in total, and the View program can operate with any combination of them being present or absent. All are DOS text files that can be edited with the EDIT program. Because the names of these files are hard-coded into the View program, they cannot be renamed. Note that all end with a .DAT suffix.

Please select a file to view more information including information to edit file.

1) DESCRIBE.DAT.: Contains any text you wish to display on the far right hand of the 3-D display

2) DATACLR.DAT.: Data Colour file to set dot colour.

3) BASEPTS.DAT.: Contains the x, y and z coordinates for any fixed data points to be included in the display.

4) BASELNS.DAT.: Contains the line-connection sequence for the Base Data Points and line colour.

5) DATALNS.DAT.: Contains the line-connection sequence for all 3-D Data Points and line colour.

6) MISC.DAT.: Contains some additional information that customized the 3-D display, including Origin location and including Analog signals to display screen.

7) FILE.DAT. : Contains the complete path of the data file being displayed.

DESCRIBE.DAT File

From the DESCRIBE.DAT file the user may customize the text viewed in the right side of the display screen. Each line can contain a maximum of 27 characters, and a total of 6 lines can be displayed. If DESCRIBE.DAT contains more than 6 lines of text additional lines will be ignored. If any line contains more than 27 characters, then the remaining characters on that line will be ignored.

Example: Description line 1
Description line 2
Description line 3

DATACLR.DAT File

The DATACLR.DAT file determines the colour of the lines and dots represented in the 3D View. Each line of this file contains 3 numbers separated by commas (,).

Each crystal is displayed as a circle of one color filled with a second color. The first number is the Circle color and the second number is the Fill color. The third number is the Size of the circle. Size can have a value of 0 to 3 (fractional values are permitted). A value of 0 makes the circle appear as a dot.

The values for the colors of the Circle and the Fill can be from 0 to 15. The order of the lines is matched to a specific crystal. The numbers that appear on line 14 of the file defines the colors and size of Crystal number 14. The last line of this file should contain the sequence 999,999,999. If no circles are to be plotted, ensure the first line contains the sequence 999,999,999.

Example: 9, 1, 2
10, 2, 2
11, 3, 2
(Etc)
999 ,999,999

BASEPTS.DAT File

This file contains the x, y and z coordinates for any fixed data points to be included in the display. Each line consists of 3 numbers separated by commas (,) where the first line represents the first Base point, the second line represents the second data point, and so on. The last line should contain the sequence 999,999,999 or, if no base points are needed, then the first line should contain 999,999,999.

Example: 0, 0, 0
10, 0, 0
9, 1, 0
9, -1, 0
0, 10, 0
1, 9, 0
-1, 9, 0
0, 0, 10
1, 0, 9
0, 1, 9
999, 999, 999

BASELNS.DAT File

BASELNS.DAT contains the line-connection sequence for the Base Data Points. Each line consists of 3 numbers, the first two being the two points that a line will be drawn between, and the third number is the color of the line. Only points that are defined in the file

BASEPTS.DAT should be referenced in this file. The last line of this file should contain 999,999,999 or, if there are no Base Data Points then the first lines should be 999,999,999.

Example: 1, 2, 11
2, 3, 11
2, 4, 11
1, 5, 13
5, 6, 13
5, 7, 13
1, 8, 14
8, 9, 14
8, 10, 14
999, 999, 999

DATALNS.DAT File

DATALNS.DAT contains the line-connection sequence for the 3-D Data Points. Each line consists of 3 numbers, the first two being the two points that a line will be drawn between, and the third number is the color of the line. The last line of this file should contain 999,999,999 or, if no lines are desired then the first line should be 999,999,999.

Example: 18, 21, 10
21, 6, 10
1, 4, 11
4, 22, 11
3, 20, 12
20, 5, 12
(etc)
999,999,999

MISC.DAT File

Description: Miscellaneous file. This file contains some additional information that customized the 3-D display. The first line contains a single number that represents a specific point the user wishes to be re-assigned as the origin. Normally, the 3-D data file contains 1 point that has already been assigned as the origin (i.e. it's xyz location is constantly 0,0,0). If this value is non-zero, then the origin will be moved to that point. If the value is zero, then the origin will not be moved.

The second line contains 5 numbers separated by commas (,). The first number is either a 0 or 1. If it is a zero, then the 3-D display will not include a separate window to display analog channel information. If it is a 1, then an analog channel display window will be displayed under the main 3-D display window. The second, third, fourth and fifth numbers can be defined as X1, X2, Y1, and Y2. The analog display window will have a width, in seconds, defined by X1 to X2, and a height (from bottom to top) defined by Y1 to Y2.

All remaining lines, (no more than 6) each contain 2 values. The first value represents an A/D channel in the 3-D file, and the second is the color of that channel when it is plotted in the analog display window.

Example:

0

1, 0, 14, -500, 500

1, 10

2, 11

The above example indicates:

1) The origin will not be moved

2) - An analog display window will be shown

- The window will represent time from 0 to 14 seconds

- The height of the window will represent -500 to 500 units.

3) The first analog data channel contained in the 3-D file will be plotted, with a color value of 10.

4) The second analog data channel in the 3-D file will be plotted, with a color value of 11.

FILE.DAT File

Description: This file contains 1 line listing the complete path and file name of the 3-D data file to display. If this file is absent, or if the it references an incorrect path, or if the data file name is wrong, then the View program will display all files in the current directory that end with .XYZ and the user will be prompted for the name of a 3-D data file to view.

Windows View3D

Windows View3D

The windows View3D provides a mechanism for users to visualize the x, y, z coordinate data generated by Sonometric's SonoXYZ application. The user is able to manipulate the generated image and thus obtain a better understanding of the crystals' orientations.

More information is available under these headings:

- Configuration Files
- Recroding AVI Files
- Mouse Functionality
- Display Modes
- Keyboard Shortcuts
- Displaying Trace Plots
- Triad Editor
- Version History

Configuration Files

The configuration file defines various parameters associated with the display of the SXA file data. There is a default configuration file (Custom3D.txt in the SONOROOT directory) that is used to display SXA files that do not have their own configuration file. If neither the default or custom file exists, View3D will setup use internally defined display parameters. An SXA file that has its own configuration file will use the information within this file as required. The SXA's configuration file will reside in the same directory as the SXA file. Its will have the same file name as the SXA file but with a ".txt" extension.

The following display parameters can be defined and modified in the configuration file:

- Axes, color and visibility
- Background color

- Boundary box visibility
- Color (default) used in subsequent operations
- Crystal, point size and color
- Center of Mass, point size and color
- Edge (or Line), definition, line size and color (for the custom display mode)
- Origin crystal definition (translation)
- Rotation angles
- Size of points and/or lines
- Timestamp visibility

Colors are defined as certain predefined keywords or as integers where if viewed in hexadecimal format would appear as 0xRRGGBB (RR is the hexadecimal representation of a number between 0 and 255 for the amount of red to display, GG similarly for green and BB for blue). The current set of recognized color keywords are: Black, Blue, Brown, Cyan, Gray, Green, Magenta, Maroon, Navy, Orange, Purple, Red, Violet, White and Yellow. Note that the parsing of the display file is case insensitive and is processed in sequence from the beginning to end, thus making the order of certain lines significant.

Recroding AVI Files

The user is able begin the process of recording an AVI file from the main "Display" menu by selecting "Record AVI" menu option. There are several steps involved in this generating an AVI:

1. Enter the desired filename.
2. Select the Frame Rate, Start and End Times.

   The frame rate defines approximately the number of frames (or time points) per second to be displayed in normal playback mode. The range in frame rates is between 5 and 60. The start and end times are in seconds. The start and end time scroll controls will respond to "Page Up" and "Page Down" keys, giving the user a faster method of modifying these values.

3. Select and configure the "Video Compression" method.

   The video compressors listed in the "Compressor" control are dependent on which video codecs are installed on the computer. These codecs compress the video information so that substantially less disk space is required to store the video image. Most windows systems appear to have the "Microsoft Video 1" codec. This codec provides reasonable compression and quality for AVI file generation (utilizing just the default values). Increasing the compression quality will result in larger files and possibly better quality playback images; generally, the compression quality becomes a tradeoff between increased file size and the quality of the play back image (the higher the quality, the larger the file size). The best desired balance will require experimenting with the various codecs and their configurations. More recent codecs may provide smaller file size with better quality playback images. Using "Full Frames (Uncompressed)" to record an AVI is not recommended, as it will result in extremely large AVI files, some 20 times larger than a compressed file. A typical compressed AVI file may require approximately 10 to 50 or more mega-bytes of disk space. The amount of disk space required depends on many factors, such as, the size of the View3D display window, the total time defined by the start and end times and the codec used to compress the video information.

4. Upon activating the "OK" button on the "Video Compression" dialog window, the View3D application will run through the range of configured time points, effectively animating the display.

NOTE: Do not modify, cover, hide, dismiss or mouse-over the View3D display during the recording phase, as it may corrupt the captured images' bitmaps in the AVI file.

When the animation stops and the message ". Finished AVI recording" appears in the status bar, the AVI recording is complete. The recording animation rate is determine by the application and should not be interfered with while recording.

Mouse Functionality

Mouse Over

- When the mouse cursor is near a crystal (or vertex), a small window appears providing the user with the crystal number and its current x, y, z values.

Left Button

- When not in Line Draw mode, holding the left mouse button down while over the image and moving the mouse provides an easy mechanism for the user to rotate and reorientate the image. If the user also depresses the "Ctrl" key, the whole image is dragged in the direction of mouse movement. Releasing the left mouse button will end the rotate/drag mode.

- In Line Draw mode, the user must first mouse over a crystal, then hold down the left mouse button and then drag the line to another crystal. The apparent thickness of the line will increase when the mouse is over another crystal. Releasing the left mouse when the line is thick, will instruct the system to either draw or erase a line between the two crystals having the user selected line thickness and color.

Right Button

- Clicking the right mouse button while in the image display area will cause a popup menu to appear. The user is able to manipulate the following from this menu:
    - animation control (stop, start, slower, faster and reverse)
    - boundary box display
    - color of the axes, background and crystal lines (except for custom display mode)
    - display of crystal numbers
    - the display mode
    - the crystal line thickness (except for custom display mode)
    - display of the time stamp
    - display of the x, y, z axes
    - the zoom level of the displayed image

  If the user's mouse is over a crystal so that the crystal information popup appears, a different popup menu appears on the right mouse click. From this popup, the user is able to:
    - change the color of the crystal point
    - change the point size of the crystal
    - display a list of distance between the selected crystal and every other crystal in the data set.

Display Modes

GL_POINTS - Treats each vertex as a single point. Vertex n defines point n. N points are drawn.

GL_LINES - Treats each pair of vertices as an independent line segment. Vertices 2n - 1 and 2n define line n. N/2 lines are drawn.

Custom - The configuration file (<file>.txt) determines the point and edge parameters. This is a variation of the GL_LINES display mode.

GL_LINE_STRIP - Draws a connected group of line segments from the first vertex to the last. Vertices n and n+1 define line n. N - 1 lines are drawn.

GL_LINE_LOOP - Draws a connected group of line segments from the first vertex to the last, then back to the first. Vertices n and n+1 define line n. The last line, however, is defined by vertices N and 1. N lines are drawn.

GL_TRIANGLES - Treats each triplet of vertices as an independent triangle. Vertices 3n - 2, 3n -1, and 3n define triangle n. N/3 triangles are drawn.

GL_TRIANGLE_STRIP - Draws a connected group of triangles. One triangle is defined for each vertex presented after the first two vertices. For odd n, vertices n, n + 1, and n + 2 define triangle n. For even n, vertices n + 1, n, and n + 2 define triangle n. N - 2 triangles are drawn.

GL_TRIANGLE_FAN - Draws a connected group of triangles. One triangle is defined for each vertex presented after the first two vertices. Vertices 1, n + 1, and n + 2 define triangle n. N - 2 triangles are drawn.

GL_QUADS - Treats each group of four vertices as an independent quadrilateral. Vertices 4n - 3, 4n - 2, 4n - 1, and 4n define quadrilateral n. N/4quadrilaterals are drawn.

GL_QUAD_STRIP - Draws a connected group of quadrilaterals. One quadrilateral is defined for each pair of vertices presented after the first pair. Vertices 2n - 1, 2n, 2n + 2, and 2n + 1 define quadrilateral n. N quadrilaterals are drawn. Note that the order in which vertices are used to construct a quadrilateral from strip data is different from that used with independent data.

GL_POLYGON - Draws a single, convex polygon. Vertices 1 through N define this polygon.

Keyboard Shortcuts

Supported keyboard shortcuts are as follows:

General

space toggle animation mode

m change the display mode, increment (see list)

M change the display mode, decrement (see list)

z zoom in on the image

Z zoom out on the image

down arrow rotate the image down

end toggle the temporal direction of playback

home reset display to first time point

left arrow rotate the image to the left

Keypad - decrease the playback speed during animation

Keypad + increase the playback speed during animation

page down rotate image about the z-axis in a counter clock wise direction

page up rotate image about the z-axis in a clock wise direction

right arrow rotate the image to the right

up arrow rotate the image up

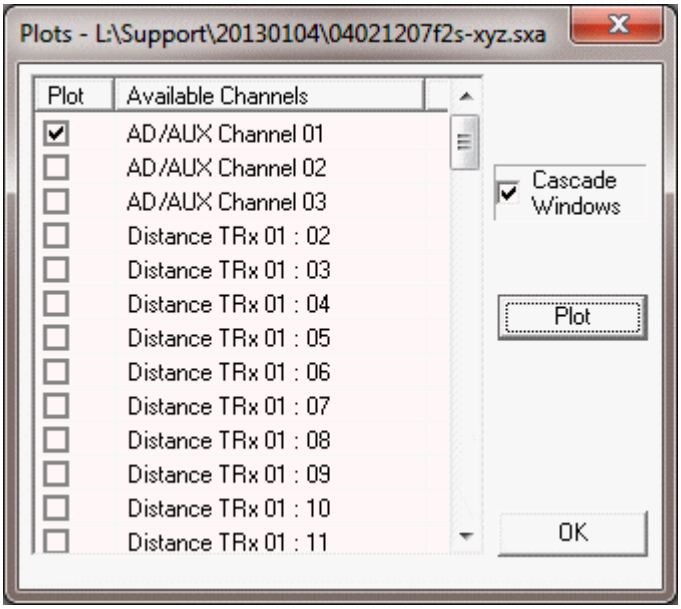
Only in Line Draw Mode

1, 2, 3, . 9 Select the line thickness (1 = fine, 9 = very thick)

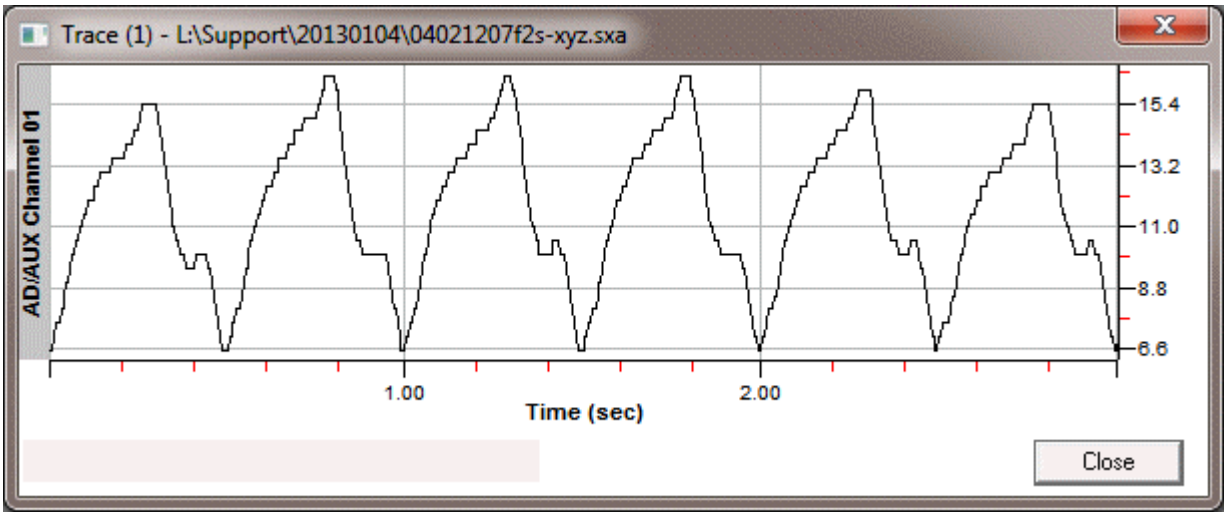
c, C display the color dialog

Displaying Trace Plots

After opening an .SXA file, the Edit menu provides a Plot sub item that will bring up a dialog similar to:

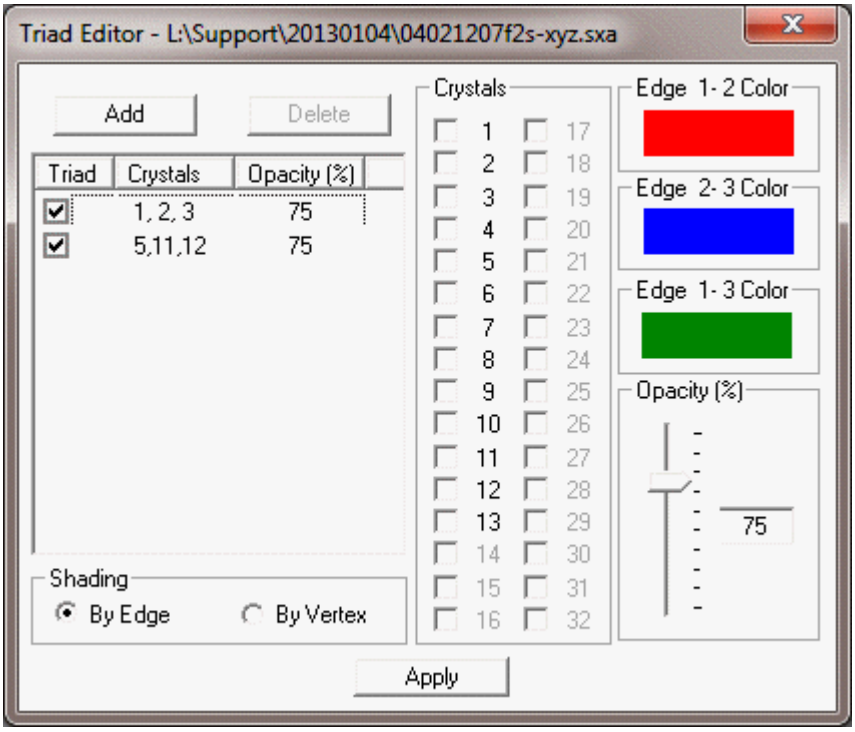


Selection of one or more items to plot (checking the box in the Plot column) will result in a Plot window(s) appearing once the Plot button has been activated. A typical Plot window:

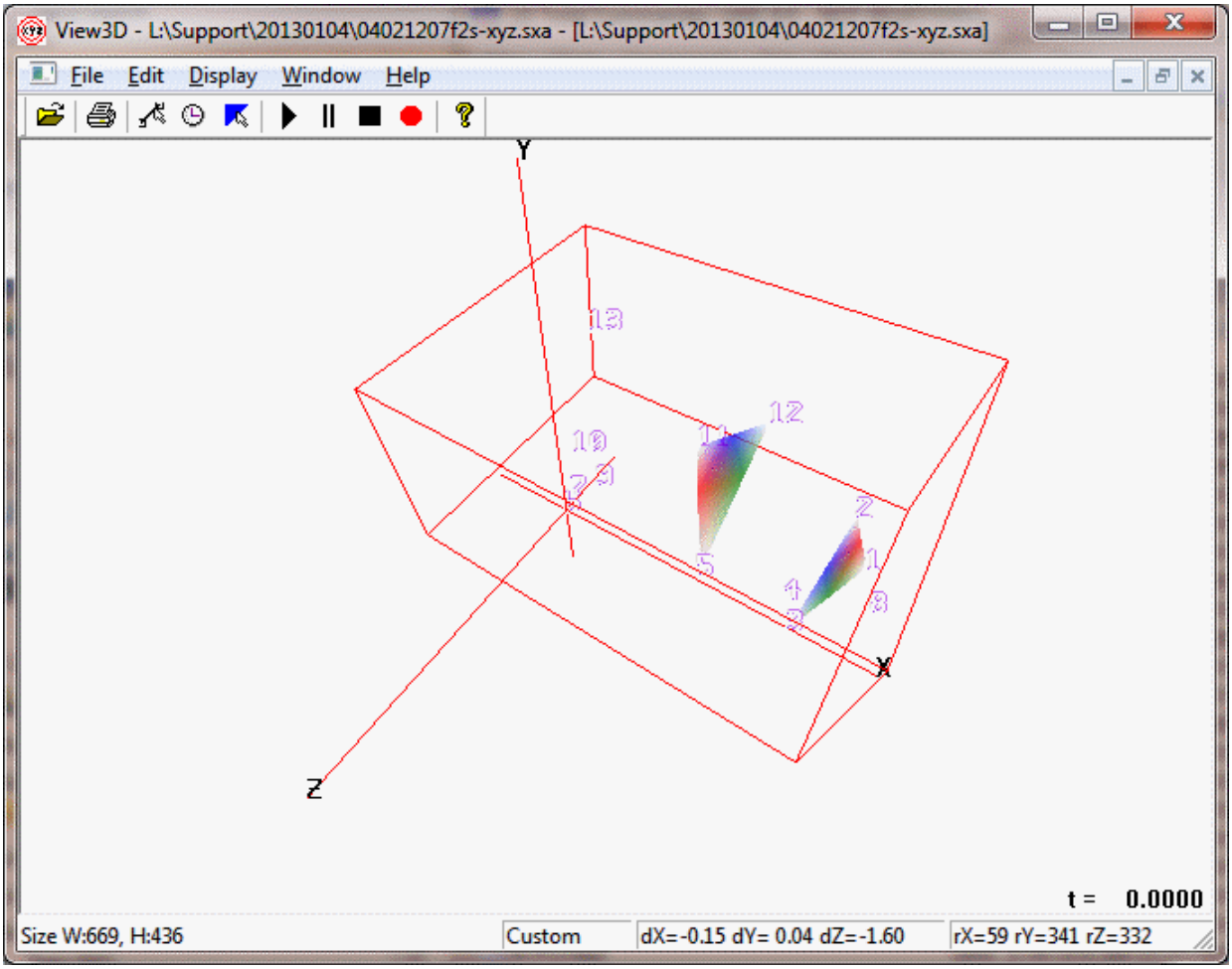


Triad Editor

The View3D allows the user to shade triangle areas by selecting a triad (three crystals) and specifying the color, shading and opacity. Selecting the Triads menu item under the Edit will result in the Triad Editor being displayed:



The user is able to select three crystals, and then the color, opacity and shading preference before adding (activate the Add button above the list) the triad to the display list. Unchecking a Triad will result in that particular Triad not being displayed. In this example, the above defined Triads displayed as follows:



This is meant as visualization tool that may help better access the data set.

Version History

Version History

- Version 1.0.0.26
- Version 1.0.0.20
- Version 1.0.0.10
- Version 1.0.0.7
- Version 1.0.0.5

Version 1.0.0.26

Since release 1.0.0.20 of the windows View3D, the following features has been added:

- The ability to display the Center of Mass points from the version 1.0.20.27 of SonoXYZ. See the SonoXYZ documentation for more details.
- A Persistent display option which will show a visual history of displayed data. The use of the mouse to reposition the display will result in the Persistent items to be erased from the current display. This feature can be toggled on (Checked) and off (UnChecked) by right clicking in the display area and selecting the Persistent menu item..

- The ability to drag .sxa files from windows explorer and drop them unto the View3D app, resulting in the file being opened.
- The user is now able to plot various AD/AUX or distance channels. This feature is invoked from the main menu Edit, Plots. This brings up the Plot dialog which permits the user to select which channels to plot.
- The user is also able to define various shaded triangles on the 3D view. This is invoked from the main menu Edit, Triads. A Triad editor dialog is presented which gives the user the ability to select the Triads in terms of of which three crystals define the triad, the colors associated with each edge or vertex and its opacity.

Version 1.0.0.20

Since release 1.0.0.10, several features have been added:

- The user is able to remap the reference crystals for the currently displayed file by activating the “Reference Crystals” from the Display menu. This will present the Reference Crystals dialog. The user is able to define a new set of reference crystals by selecting the appropriate values in each of the drop down boxes. The OK button will be enabled after all of the values have been modified appropriately. NOTE: The remapped configuration is not saved upon closing the file.
- The time slider dialog will appear when an x,y,z file has been opened.
- The display configuration is automatically saved when the file is closed.
- The AVI recording was modified so that the default frame rate is close to a real-time play back.

Version 1.0.0.10

The user now has the ability to remap the reference crystals utilizing the "Display", Reference Crystals" dialog. The dialog shows the current reference crystals used for the origin, x-axis xy-plane and z-axis orientations. The user is able to select new references and subsequently have these displayed.

A "Time Selector" dialog has been added to the "Display" menu and the toolbar. This dialog permits the user to easily select any time point in the file for display.

Version 1.0.0.7

Some minor problems were corrected in this release. On some computers the AVI record feature does not capture properly. An additional option "Per Pixel" has been added to the AVI record configuration dialog. This forces the application to capture the image on a per pixel basis and works on those systems which previously had difficulties. This method is significantly slower and is only recommended if the default capture method is not working properly.

Version 1.0.0.5

Menu options include File, Edit, Display, Window and Help. From the File menu selection the user is able to:

- Open a file for display
- Close the current display
- Open a previously opened file from the list of previously viewed files
- obtain the File Information for the current active file being displayed. The source SXA file is opened in Notepad.
- Exit the application.

The Edit menu currently gives the user the ability to toggle into and out of Line Draw mode on the currently displayed file. The Display menu offers the user the ability to:

- Animate the selected display (Start, Stop, Faster, Slower and Reverse)
- select the Display Mode (see Supported Display Modes below)
- Open a display Configuration file

- Record an AVI file for the current display
- Save the current display settings as the Default Configuration
- Save the current display Configuration
- toggle the visibility of the toolbar
- toggle the visibility of the status bar

The Window menu allows the user to tile, cascade or select the display. The Help menu currently displays the version information for View3D.

Appendix A: File Extension Definitions

Appendix A: File Extension Definitions

.**b	Old SonoLAB Binary	Original raw data files collected in SonoLAB. These files are data files before they are opened in SonoVIEW.	Data.01b
*.slb	SonoLAB Binary Data	Raw data files which have been previously opened in SonoVIEW.	Data01.slb
*.ssb	SonoSOFT Binary Data	Data files that have been filtered and or calculations performed with.	Data01.ssb
*.ssa	Trace ASCII Data	Trace Zone data converted and saved into ASCII format	Data01.ssa
*.sca	Data Zone ASCII Data	Data Zone spreadsheet saved into ASCII format	Data01.sca
*.scb	CardioSOFT Binary File		
*.sct	CardioSOFT Setup Template	Template file saved along with binary file containing calculation information in screen set up.	
*.sst	SonoSOFT Display Template		
*.scp	CardioSOFT Protocol	Template for Calculations to be performed in Analysis	Protocol2.scp

Appendix B: Calculations in CardioSOFT

Appendix B: Calculations in CardioSOFT

1) LV Volume and Whole Heart Volume.
2) Mathematics.
3) Trace Value.
4) Cardiac.
5) Gastro Intestinal Calculations
6) Spectra

7) Area Calculations

LV Volume and Whole Heart Volume

LV Volume and Whole Heart Volume

When measuring left ventricular volume or right ventricular volume, apex/base major axis (ABaxis) must be available. Ten different heart model options are available to estimate left ventricular volume and entire heart volume. Right ventricular volume can be obtained by subtracting left ventricular volume from total heart volume.

1) For Single Axis (Apex to Base axis only):

2) For Two Axis (Apex to Base axis and a Minor axis)

3) For Three Axis (Apex to Base axis, Anterior to Posterior axis, and Minor axis 2)

4) Four Distance Ellipsoid Model

Four Distance Ellipsoid Model

Volume = (pi * LongAxis * ShortAxis * ShortAxis / 6) – WallVolume

Where ShortAxis is the radius of the circumscribed circle passing through the apexes of the triangle defined by Dist1, Dist2 and Dist3

For Single Axis (Apex to Base axis only):

For Single Axis (Apex to Base axis only):

1) Spherical Model.

2) Cubic Model.

3) Cylindrical Model.

4) Paraboloid Model

Spherical Model:

Volume = p * AB-axis * AB-axis * AB-axis / 6

Cubic Model:

Volume = AB-axis * AB-axis * AB-axis

Cylindrical Model:

Volume = p * AB-axis * AB-axis * AB-axis / 4 (height = radius)

Paraboloid Model:

Volume = p * AB-axis * AB-axis * AB-axis / 8 (height = radius)

For Two Axis (Apex to Base axis and a Minor axis)

For Two Axis (Apex to Base axis and a Minor axis)

Allows definition of M axis1 as Anterior to Posterior axis or Septal wall to Free wall axis in left ventricle, as Anterior to Posterior axis or Left ventricle to Right ventricle axis in whole heart.

1) Ellipsoid Model.

2) Rectangular Parallelepiped Model.

3) Cylinder Model.

4) Paraboloid Model.

Ellipsoid Model:

Volume = p * AB-axis * M-axis1 * M-axis1 / 6

Rectangular Parallelepiped Model:

Volume = AB-axis * M-axis1 * M-axis1

Cylinder Model:

Volume = p * AB-axis * M-axis1 * M-axis1 / 4

Paraboloid Model:

Volume = p * AB-axis * M-axis1 * M-axis1 / 8

For Three Axis (Apex to Base axis, Anterior to Posterior axis, and Minor axis 2)

For Three Axis (Apex to Base axis, Anterior to Posterior axis, and Minor axis 2)

Allows definition of Minor axis 2 as Septal wall to Free wall axis in left ventricle and as Left ventricle to Right ventricle axis in whole heart.

1) Ellipsoid Model.

2) Rectangular Parallelepiped Model.

Ellipsoid Model:

Volume = p * AB-axis * AP-axis * M-axis2 / 6

Rectangular Parallelepiped Model:

Volume = AB-axis * AP-axis * M-axis2

Mathematics

Mathematics

1) Derivative.

2) Integral

3) Addition, Subtraction, Multiply, and Divide

4) Conductance Catheter Correction

5) Analog Channel Correction

6) Threshold Integral

Derivative (Driv):

Where V(t+1) is a trace value at time point t+1, V(t-1) is the trace value at the time point t-1.

dV/dt=(V(t+1)-V(t-1))/2

Integral

Where V(t) is a trace value at time point t.

Intg(V)=sum of V(t) during a period

Addition, Subtraction, Multiply and Divide

Functions will be performed on two channels to create a new trace.

Conductance Catheter Correction

$V_{corrected}(t) = 1/alpha * (V_{cc}(t) - V_c)$

Where $V_{cc}(t)$ is the Conductance Catheter Volume at time t

alpha is the dimensionless slope factor

V_c is the Parallel Conductance.

Given Vc and Alpha, the Conductance Catheter Correction (CCC) calculation will generate a "corrected" LVV Aux trace from the Conduction Catheter total volume trace. See Conductance Catheter Alpha for more details.

Analog Channel Correction

ADC trace correlation and slope/offset adjustment.

ADCuncal is time-correlated with ADCref, ADCuncal's slope and offset are adjusted to minimize the least squares difference between ADCuncal and ADCref.

Threshold Integral

Integrates the values of the given trace between cross-over points determined from the user defined threshold value.

tintg(V) = SUM of V(t) * Uc

where V(t) is a trace at time point t.

Uc is a conversion factor. A commonly used unit conversion factor is 0.0166667 (=1/60) to convert from units/min to units/sec.

Trace Value

Trace Value

1) Heart Rate (HR)
2) Maximum (Max)
3) Minimum (Min)
4) Mean
5) End Diastole Magnitude (EDM)
6) End Systole Magnitude (ESM)
7) Developed Index ED-ES
8) Developed Index Max-Min
9) nValue Trace Value At Negative Edge
10) pValue Trace Value At Positive Edge
11) Value At Maximum (Val@Max)
12) Value At Minimum (Val@Min)

Heart Rate (HR)

Where HR is Heart Rate (beat per minute)

HR=1/(time period in a beat)

Maximum (Max)

Where V(t) is a trace value at time point t.

MAX = Maximum (V(t)) in a period

Minimum (Min)

Where V(t) is a trace value at time point t.

MIN = Minimum (V(t)) in a period

Mean

Where V(t) is a trace value at time point t.

MEAN = (SUM of V(t))/(number of points) in a period

End Diastole Magnitude (EDM)

Where V(ED) is a trace value at End Diastole

EDM = V(ED)

End Systole Magnitude (ESM)

Where V(ES) is a trace value at End Systole

ESM = V(ES)

Developed Index ED-ES

DEVI1 = V(ED) – V(ES)

Where V(ED) is the trace value at End Diastole
V(ES) is the trace value at End Systole.

Developed Index Max-Min

DEVI2 = V(Max) – V(Min)

Where V(Max) is the trace value at a cyclic Maximum
V(Min) is a trace at a cyclic Minimum.

nValue Trace Value At Negative Edge

This calculation determines the values of a targeted trace at the time points defined by the transition from a value above the user defined threshold to a value below this threshold on the reference trace.

nValue = Trace(t=Ref(@Value-))

where Trace is the targeted trace

Ref is the reference trace used to determine the time point at which the reference trace's value transitions under the user -defined threshold value. This is done for each specified interval

The nValue calculation will generate two cyclic parameter columns, one for the values of the targeted trace and the other for the time points at which these values occur. The time points are defined by the location, within a given interval, where the reference trace's value transitions from a value above the user defined threshold to a value below the threshold.

pValue Trace Value At Positive Edge

This calculation determines the values of a targeted trace at the time points defined by the transition from a value below the user defined threshold to a value above this threshold on the reference trace.

pValue = Trace(t=Ref(@Value+))

where Trace is the targeted trace

Ref is the reference trace used to determine the time point at which the reference trace's value transitions over the user -defined threshold value. This is done for each specified interval

The pValue calculation will generate two cyclic parameter columns, one for the values of the targeted trace and the other for the time points at which these values occur. The time points are defined by the location, within a given interval, where the reference trace's value transitions from a value below the user defined threshold to a value above the threshold.

Value At Maximum (Val@Max)

The Value@ Maximum (Val@Max) calculation determines the values of the target trace at the time points defined by the maximums of the reference trace.

Val@Max = Trace(t=Ref(@Maximum))

where Trace is the targeted trace

Ref is the reference trace used to determine the time points at which the reference trace's values are a maximum within the prescribed period interval.

The Val@Max calculation will generate two cyclic parameter columns, one for the values of the targeted trace and the other for the time points at which these values occur.

Value At Minimum (Val@Min)

The Value@ Minimum (Val@Min) calculation determines the values of the target trace at the time points defined by the minimums of the reference trace.

Val@Min = Trace(t=Ref(@Minimum))

where Trace is the targeted trace

Ref is the reference trace used to determine the time points at which the reference trace's values are a minimum within the prescribed period interval.

The Val@Min calculation will generate two cyclic parameter columns, one for the values of the targeted trace and the other for the time points at which these values occur.

Cardiac

Cardiac

1) Stroke Volume (SV)
2) Cardiac Output (CO)
3) Ejection Fraction (EF)

4) Wall Thickening Percentage at ES (WT%1)
5) Wall Thickening Percentage at Maximum (WT%2)
6) Segmental Shortening Percentage at End Systole (SS%1)
7) Segmental Shortening Percentage at Minimum (SS%2)
8) Stroke Work (SW)
9) End-Systolic Pressure Volume Ratio (Maximal Elastance - Emax)
10) End-Systolic Pressure Volume Ratio 2 (Maximual Elastance – Emax2)
11) End Diastole Pressure Volume Relationship (EDPVR)
12) Pressure Volume Area (PVA)
13) Preload Recruitable Stroke Work (PRSW)
14) Segmental Strain
15) Single Beat Preload Recruitable Stroke Work (SBPRSW)
16) Conductance Catheter Parallel Conductance
17) Time Constant of Isovolumic Relaxation (Tau 1) Zero Asymptote
18) Time Constant of Isovolumic Relaxation (Tau 2) Floating Asymptote
19) Time Constant of Isovolumic Relaxation (Tau 3) Logistic Model:
20) Conductance Catheter Alpha
21) Conductance Catheter Total Segment Volume
22) Arterial Elastance
23) Arterial-Ventricular Coupling

Stroke Volume (SV)

Difference of left ventricular volume between ED and ES in each cardiac cycle.

SV=LV_V(ED)-LV_V(ES)

Cardiac Output (CO)

Instantaneous heart rate times SV in each cardiac cycle.

CO=SV*HR

Ejection Fraction (EF)

Ratio of SV to end-diastolic left ventricular volume in each cardiac cycle.

EF=(LV_V(ED)-LV_V(ES))/LV_V(ED)

Wall Thickening Percentage at ES (WT%1)

Change in wall thickness at end systole and end diastole as a percentage.

WT%=(WT(ES)-WT(ED))/WT(ED)

Wall Thickening Percentage at Maximum (WT%2)

Changes in wall thickness between maximum distance and end diastole as a percentage.

WT%=(WT(Max)-WT(ED))/WT(ED)

Segmental Shortening Percentage at End Systole (SS%1)

Changes in a segment length at end systole and end diastole as a percentage.

SS%=(SL(ED)-SL(ES))/SL(ED)

Segmental Shortening Percentage at Minimum (SS%2)

Changes in segment length between minimum distance and end diastole as a percentage.

SS%=(SL(ED)-SL(Min))/SL(ED)

Stroke Work (SW)

Area in the PV loop of each cardiac cycle.

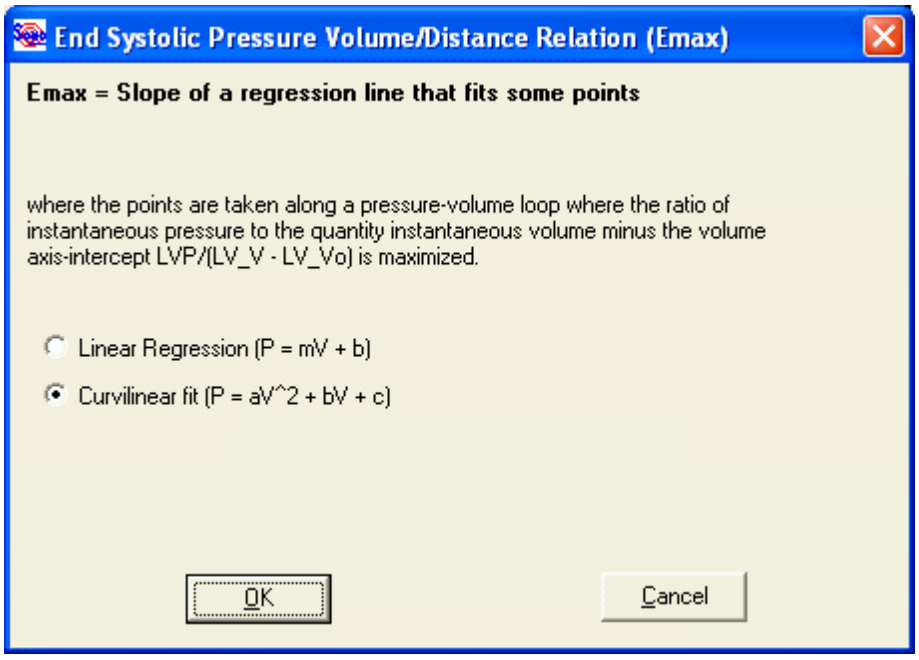
SW=SUM of (LV(i)-LV(i+1))*(LVP(i)+LVP(i+1))/2 in a beat

End-Systolic Pressure Volume Ratio (Maximal Elastance - Emax)

Maximal Elastance for a pressure-volume relation is defined as the points along a pressure-volume loop where the ratio of instantaneous pressure to the quantity instantaneous volume minus the volume axis-intercept LVP/(LV_V-LV_Vo)is maximized.

Emax = slope of a regression line that fits some points

Beginning with version 3.4.44 of SonoSOFT, a curvilinear fit can be selected for the ES pressure volume relationship. To invoke the curvilinear fit, one must select the “Equation” button on the Analysis window. The following window should appear:



By default the “Linear Regression” radio button is set. If curvilinear fit is desired, select the “Curvilinear” radio button and then activate the OK button.

The linear regression ESPVR will generate three complex parameters, which will appear in the Complex data grid. The parameters are: slope, Vo and r-value. Vo is the x axis intercept of the line of best fit to the Emax points. r-value is the correlation coefficient (Pearson’s r).

The curvilinear fit generates four parameters to the Complex data grid. These are the calculated coefficients for the quadratic equation (a,b,c) and chi-square. The curvilinear fit is based on:

> Burkhoff D, Sugiura S, Yue DT, Sagawa K: Contractility dependent curvilinearity of end-systolic pressure-volume relations. Am J Physiol 1987;252(Heart Circ Physiol 21): H1218-H1227

A Marquardt nonlinear least-squares algorithm was used to fit the end-systolic pressure-volume points to the equation:

$$P_{es} = a*V_{es}^2 + b*V_{es} + c$$

End-Systolic Pressure Volume Ratio 2 (Emax2)

Maximal Elastance for a pressure-volume relation is defined by the points along a pressure-volume loop where the normalized distance between a point in the upper-left quadrant of the PV Loop and the PV Loop centroid is maximized.

Emax2 = slope of a regression line that fits the Emax2 points

NOTE: this algorithm is best used when the systolic pressure decreases during the ejection phase. Also, it is not possible to have both Emax calculations active at the same time.

Also, see End-Systolic Pressure Volume Ratio (Maximal Elastance - Emax) for help on using a curvilinear fit instead of a linear one.

End Diastole Pressure Volume Relationship (EDPVR)

Exponential relationship between Pressure and volume at end diastole.

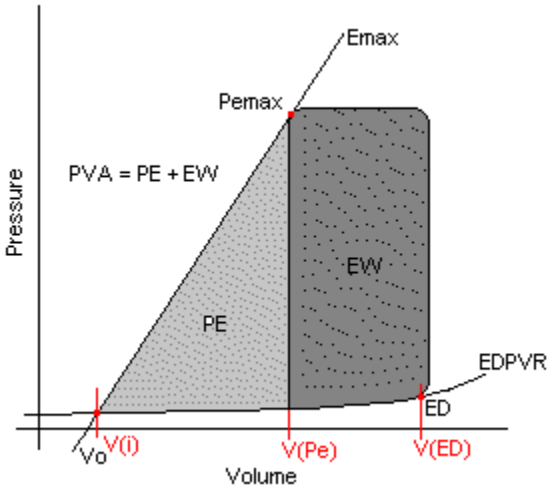
A least-square exponential fit to LVP(ED)=D*exp(Kp*LV(ED)) in several beats

Reference: Pagel PS, Kampine JP, Schmeling WT, Warltier DC, “Alteration of left ventricular diastolic function by desflurane, isoflurane, and halothane in the chronically instrumented dog with autonomic nervous system blockade.”, Anesthesiology 1991; 74: 1103–14.

NOTE: SonoSoft reports D as the “const” and Kp as the “stiffness” (often called the *chamber stiffness constant*) in the Complex data zone display.

Pressure Volume Area (PVA)

Areas associated with a PV-Loop, Emax and EDPVR. This will generate two Cyclic Parameter columns, one for PVA and one for PE.



PVA = EW + PE

where

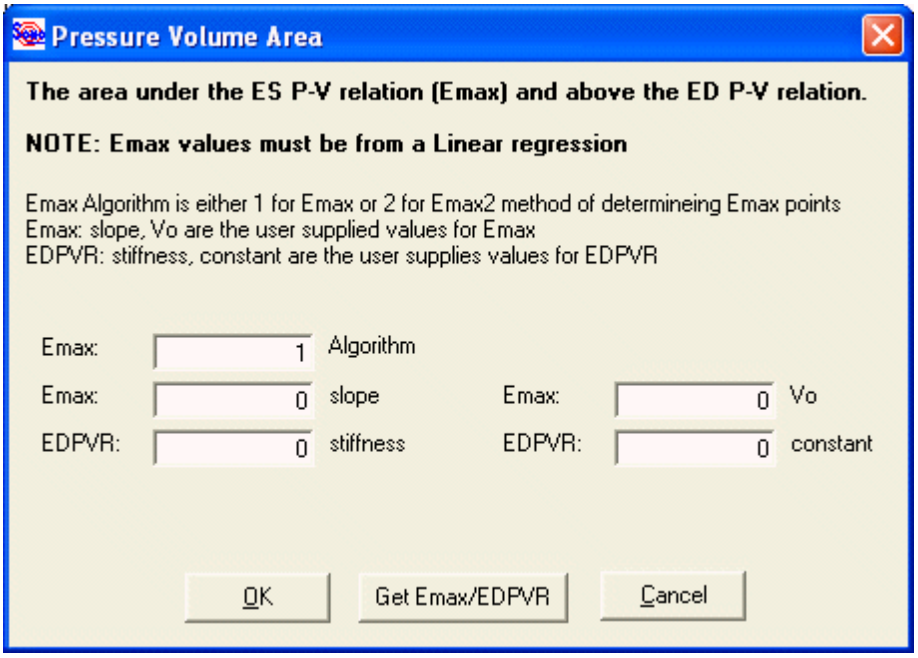
- PVA is the Pressure Volume Area
- PE is the Potential Energy
- EW is the External Work (= SW Stroke Work)

Recommended Procedure:

1. The PVA calculation is dependent on the Emax and EDPVR complex parameters. For that reason, it is recommended that a region of the file be highlighted and the Emax and EDPVR calculations be performed on the highlighted region. Note the Emax calculation (either Emax or Emax2); the Emax complex parameters(slope and Vo); and the EDPVR complex parameters (stiffness and const)
2. Add the PVA calculation to your current protocol, selecting the appropriate channels.
3. Select the PVA calculation and activate the “Equation” button. This will bring up the PVA equation parameters window (see below)
4. Fill in the various fields with the values noted in step 1), dismiss the window by activating the “OK” button.
5. Calculate the PVA cyclic parameters by activating the “Calculate” button on the Analysis Dialog window.

Once the values for the equation parameters have been entered for the PVA calculation, it is not necessary to have a highlighted region. With the highlights removed, the PVA calculation will determine the values over the whole range of cycles using the Emax and EDPVR values specified in step 4) above.

From the SonoSoft Analysis Dialog, with the PVA calculation selected, clicking on the “Equation” button will present the modifiable parameters for the PVA calculation. By default, the Emax Algorithm is set to 1, and the other fields are set to 0. NOTE: If the Emax: slope, Vo and EDPVR: stiffness, constant fields are left as 0, the Emax and EDPVR are calculated within the PVA calculation, irrespective of other Emax and EDPVR calculations. These calculations will be valid provided an appropriate region has been highlighted on the SonoSoft trace view.



The “Get Emax/EDPVR” button will attempt to load the Emax and EDPVR values currently stored in the Complex Parameters. Since it is possible to calculate a curvilinear Emax, SonoSoft will search for the first occurrence of a linear Emax. If none are found, an error message is presented to the user. If multiple Emax calculations are present, the first linear Emax is selected. The user will have to manually input the Emax values if this is not the desired set.

Preload Recruitable Stroke Work (PRSW)

Linear relation between stroke work and end-diastolic volume.

A least-squares linear fit to SW=K*LV(ED)+C in several beats

Reference: Donald D. Glower, John A. Spratt, Nicholas D. Snow, J. Scott Kabas, James W. Davis, Craig O. Olsen, George S. Tyson, David C. Sabiston Jr., J. Scott Rankin, "Linearity of the Frank-Starling relationship in the intact heart: the concept of preload recruitable stroke work", Circulation

, Vol. 71, No. 5, 1985, pp. 994-1009.

Segmental Strain

The Segmental Strain is a dimensionless quantity giving the normalized strain in each beat. The results of the calculation are returned in an auxiliary channel.

SgStrn = (L – Lo) / Lo

where L is the segment length within the current ED to ED cycle, Lo is the segment length at ED.

Reference: http://folk.ntnu.no/stoylen/strainrate/index.html#Website_index

Single Beat Preload Recruitable Stroke Work (SBPRSW)

Relationship between stroke work and volume at end diastole where k is a constant of 0.7 and an estimation of wall volume and end diastolic volume can be made.

SBPRSW=SW/(EDV-k*EDV(b)+(1-k)*WallVol) in a single beat

Reference: Karunanithi MK, Feneley MP, "Single-beat determination of preload recruitable stroke work relationship: derivation and evaluation in conscious dogs.", J Am Coll Cardiol. 2000 Feb;35(2):502-13.

Conductance Catheter Parallel Conductance

Identity-line intercept of a least-squares linear fit with errors in both (x,y) to catheter {V(ES), V(ED)} during hypertonic saline calibration procedure.

Where V(ES) and V(ED) is the catheter total Volume at ES and ED respectively

Vc is the intercept with the identity-line

Conductance Catheter Volume Correction: The values reported are the slope, offset, r-value, and the intersection of this line with the identity line (Vc) in the Complex Parameters grid. The line fit is based upon a series of (Ved, Ves) points with errors in both (x,y), thus the line fit is a least-squares fit of the perpendicular distance from the line to the points. The Vc calculation will work over an entire trace, however the intended usage is to highlight the trace region of increasing (only) volume corresponding to the injection of a bolus of saline. The 2D plot shows the Vc line. One can also plot EDM vs. ESM to show the individual points.

Time Constant of Isovolumic Relaxation (Tau 1) Zero Asymptote:

Where P(t) is LV pressure during isovolumic relaxation period, Pasym is a nonzero asymptotic pressure, P0 is an amplitude constant, t is time, Tau is the time constant of the exponent.

P(t) = P0*exp(-t/Tau) + Pasym

Time Constant of Isovolumic Relaxation (Tau 2) Floating Asymptote:

Where LVP(t) Left Ventricular Pressure, LVPo is Left Ventricular Pressure at End Systole, Tau is the derived time constant, Pasym is a nonzero pressure.

A least-squares exponential fit to LVP(t)=LVPo*exp(-t/Tau)+pasym during isovolumic relaxation period.

Reference: H. Matsubara, M. Takaki, S. Yasuhara, J. Araki, H. Suga, "Logistic Time Constant of Isovolumic Relaxation Pressure-Time Curve in the Canine Left Ventricle", Circulation, Vol. 92, No. 8, 1995, pp. 2318-2326.

Time Constant of Isovolumic Relaxation (Tau 3) Logistic Model:

Tau 3 is the Logistic Time Constant associated with the Logistic Model for LV P(t) during the isovolumic relaxation period. The Logistic Model is given by the equation:

$$P(t) = \frac{P_A}{1 + e^{t/T_L}} + P_B$$

Where P(t) is Left Ventricular Pressure, P_A is an amplitude constant, P_B is a non-zero asymptote, t is the time and T_L (or Tau 3) is the logistic time constant.

The calculation is based on the time derivative of the above Logistic Model, namely:

$$\frac{dP}{dt} = -\frac{P_A}{T_L}\frac{e^{t/T_L}}{(1+e^{t/T_L})^2}$$

By substituting the first equation into the second, we obtain a quadratic equation relating P(t) and dP/dt:

$$\frac{dP}{dt} = \frac{1}{P_A T_L}\left(P_B(P_A + P_B) - (P_A + 2P_B)P(t) + P(t)^2\right)$$

or

$$\frac{dP}{dt} = a_1 + a_2 P(t) + a_3 P(t)^2$$

This relationship is used to determine T_L by doing a least squares fit between dP/dt and P(t) to obtain the values for a_1, a_2 and a_3 and subsequently calculating T_L using the equation:

$$T_L = \sqrt{\frac{1}{({a_2}^2 - 4a_1 a_3)}}$$

Reference: H. Matsubara, M. Takaki, S. Yasuhara, J. Araki, H. Suga, "Logistic Time Constant of Isovolumic Relaxation Pressure-Time Curve in the Canine Left Ventricle", Circulation, Vol. 92, No. 8, 1995, pp. 2318-2326.

Conductance Catheter Alpha

Alpha is the dimensionless slope factor: the conductance stroke volume divided by the reference stroke volume as determined by thermal dilution and/or the difference between V(ED) and V(ES), and/or flow and/or LVV from crystal data.

Alpha = SVcc/Svref

Vcorrected = 1/Alpha * (Vcc –Vc)

Where Vc correction has NOT been applied to the CSV.

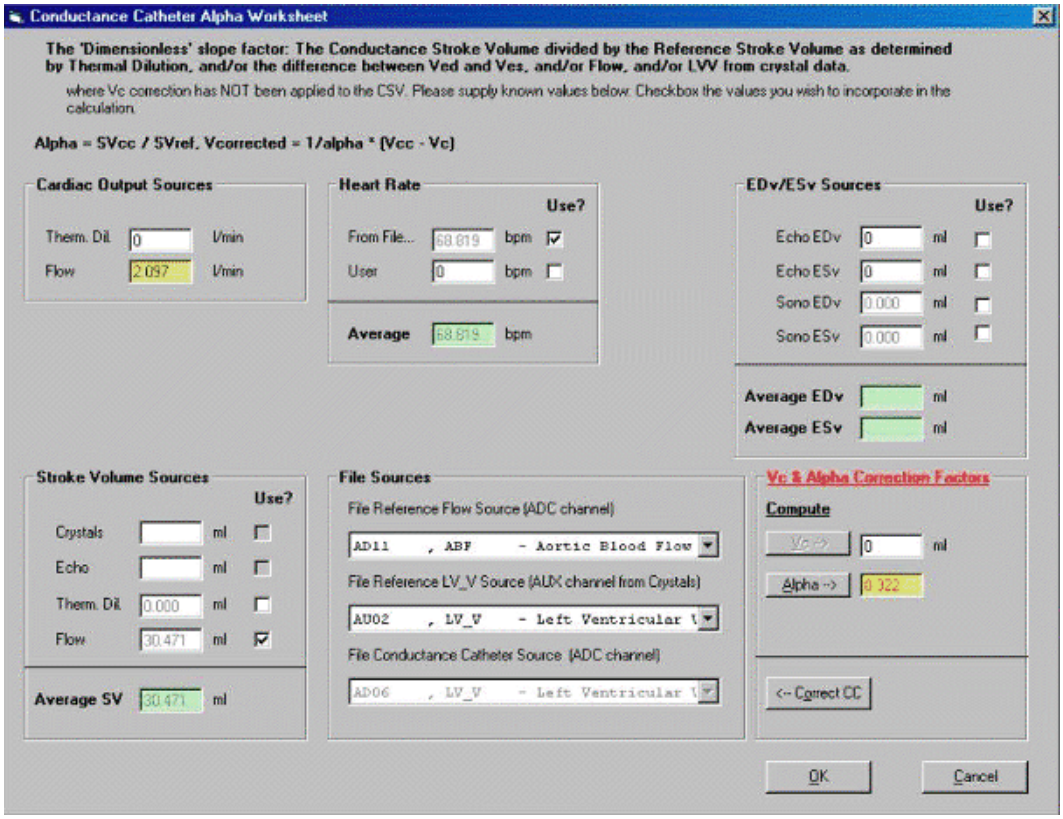
The steps are as follows:

First calculate Vc from a hypertonic saline run:

- Highlight the region of the conductance catheter trace where LVV appears to be rising, which corresponds to the hypertonic saline bolus reaching the catheter
- Run the **CardiacèVc** calculation from the analysis page
- The **Complex Parameters** grid will give the Vc result.

Next, compute Alpha:

- Select the **CardioèAlpha** calculation on the analysis page
- “kick it over”, i.e. press the << button
- Click the radio button next to the Alpha calculation
- Press the **Worksheet** button and you should see the following window:



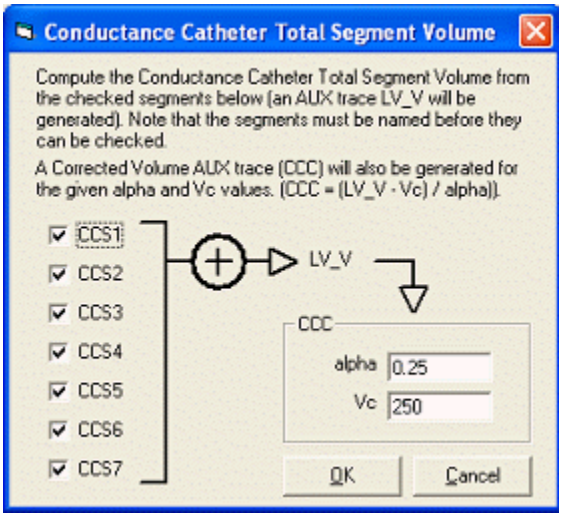
Values with a yellow background are computed from the trace data but may be edited. Values in a gray font are computed values that cannot be overridden. Some values have a checkbox associated with them. All the values checked within a group are averaged and the result appears in the textbox with a light-green background. These average values are what is used in the calculation and cannot be changed.(… However, one can check only one value within a group and edit that value, in which case the "green" average value is the same.)

- When everything is set, press the **Alpha** button to compute Alpha.
- For your convenience, enter the Vc value (from the Complex Parameters grid) and press the **Correct CC** button. This will enter a **CCC** (**C**onductance **C**atheter **C**orrection) calculation into the analysis page with the Vc and Alpha values that appear on this worksheet. The **CCC** can also be entered manually from the Analysis page (**MathèCCC**), however, then the user would have to select that calculation and press the **Equation** button to enter Vc and Alpha. This saves time. The CCC will generate a new AUX channel (named CCC) that represent the corrected conductance catheter trace.

Conductance Catheter Total Segment Volume

Given a set of Conductance Catheter segment measurements, labeled CCS1, CCS2, CCS3, …, CCS7, the Cardio, CCLV calculation derives the volume by summing the selected segments. This calculation will also generate a secondary auxiliary channel with the corrected volume. The corrected volume is dependent on the values entered for alpha and Vc.

The typical process for setting up this volume calculation is to activate the Analysis window, select the "Cardio – Cardiac" Category, then the "CLVV – Cn. Cath. seq. total volume" Model and then activating the "<<<" transfer button. The user can then select this calculation by activating the appropriate calculation selection radio button. Activating the Equation button will present the following window:



The user is able to select which segments are to be used in the volume calculation and to enter the values (alpha and Vc) needed for the corrected volume calculation. Activating the compute button will result in two auxiliary channels being generated, one labeled as LV_V and the other as CCC. The user may have to determine the values for alpha and Vc by utilizing the Conductance Catheter Alpha worksheet. Once these values have been determined, they can be entered into the CCLV equation parameters and recalculated.

Arterial Elastance

The Arterial Elastance (also called the Effective Arterial Elastance) is a characterization of the arterial load in the time domain.

Ea = LVP(ES) / SV

where SV = LV_V(ED) - LV_V(ES)

The calculation will generate one Cyclic parameter column in the Data Zone. It will be labeled Ea.

References:

- Paul D. Chantler, Edward G. Lakatta and Samer S. Najjar, “Arterial-ventricular coupling: mechanistic insights into cardiovascular performance at rest and during exercise”, *J Appl Phsysiol* 105:1342-1351, 2008.
- David A. Kass, “Age-related Changes in Venticular-Arterial Coupling: Pathophysiologic Implications”, *Heart Failure Reviews*, 7:51-62, 2002

Arterial-Ventricular Coupling

Arterial-Ventricular Coupling (AVC) is a measure of the interaction between the Left-Ventricular and the arterial system.

AVC = Ea / Elv

= (LVP(ES) / SV) / (LVP(ES) / (LV_V(ES) - Vo))

where Ea is the arterial elastance (= LVP(ES) / SV)

LVP(ES) is the Left Ventricular End-Systolic Pressure

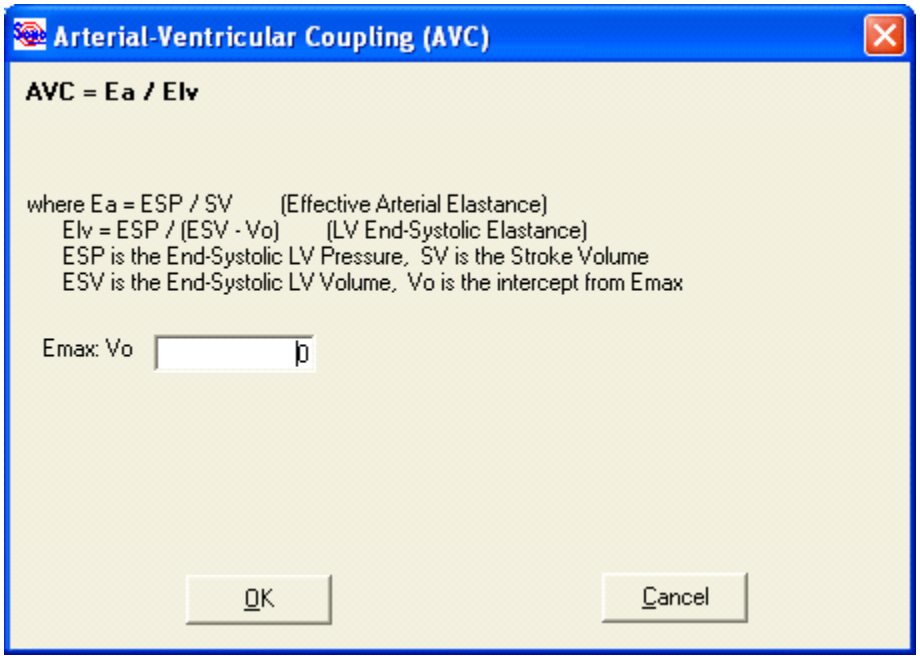
SV is the stroke volume

Elv is the Left Ventricular End-Systolic Elastance (= LVP(ES) / (LV_V(ES) – Vo))

LV_V(ES) is the Left Ventricular End-Systolic Volume

Vo is the x axis intercept of the line of best fit to the Emax points (Linear Regression)

The calculation will generate two Cyclic parameter columns in the Data Zone. The first one will be labeled AVC and the second Elv. In the Analysis dialog window, the Equation button will cause the following window to appear:



The user is able to enter a value for Emax x-axis intercept (Vo, assuming Linear Regression) in this dialog. The default value is set to 0.

References:

- Paul D. Chantler, Edward G. Lakatta and Samer S. Najjar, “Arterial-ventricular coupling: mechanistic insights into cardiovascular performance at rest and during exercise”, *J Appl Phsysiol* 105:1342-1351, 2008.
- David A. Kass, “Age-related Changes in Ventricular-Arterial Coupling: Pathophysiologic Implications”, *Heart Failure Reviews*, 7:51-62, 2002

Gastro Intestinal

Gastro Intestinal Calculations

The Gastro-Intestinal calculations provided are:

1. Phasic Component
2. Respiratory Filtered
3. Tonic Component

Phasic Component

Returns the specified trace with the low frequency components removed. Parameters used in this calculation:

“Average” is the time in seconds for the averaging filter

“Spike Filter” is the number of standard deviations used for the spike filtering threshold

“Respiratory” is the time window in seconds for the respiratory filter

Respiratory Filtered

Returns the specified trace with the spike and averaging filters applied. This is designed to remove the trace artifacts associated with respiration. Parameters used in this calculation:

“Average” is the time in seconds for the averaging filter

“Spike Filter” is the number of standard deviations used for the spike filtering threshold

"Respiratory" is the time window in seconds for the respiratory filter

Tonic Component

Applies the median value of the trace over the surrounding t seconds for the given TRX, ADC or AUX trace. Parameters used in this calculation:

"Average" is the time in seconds for the averaging filter

"Spike Filter" is the number of standard deviations used for the spike filtering threshold

"Respiratory" is the time window in seconds for the respiratory filter

Spectra - Spectrum Analysis

Spectra - Spectrum Analysis

1) Fast Fourier Transform.

2) Arterial Impedance.

3) Arterial Impedance (Heart Rate)

Fast Fourier Transform

FFT = Normalized Amplitude of Fast Fourier Transform of V(t)

Where data length is truncated to the power of 2(4096 points)

Arterial Impedance

$Z(w)= |P(w)|^2 / (F(w) * conj(P(w)))$

Where Z(w) is the complex value of Arterial Impedance that consists of Modulus and Phase

P(w) is FFT of pressure

|P(w)|^2 is a power of P(w)

F(w) is FFT of flow

Conj (P(w)) is complex conjugate of P(w)

Data Length is truncated to power of 2 (4096 points).

Arterial Impedance (Heart Rate)

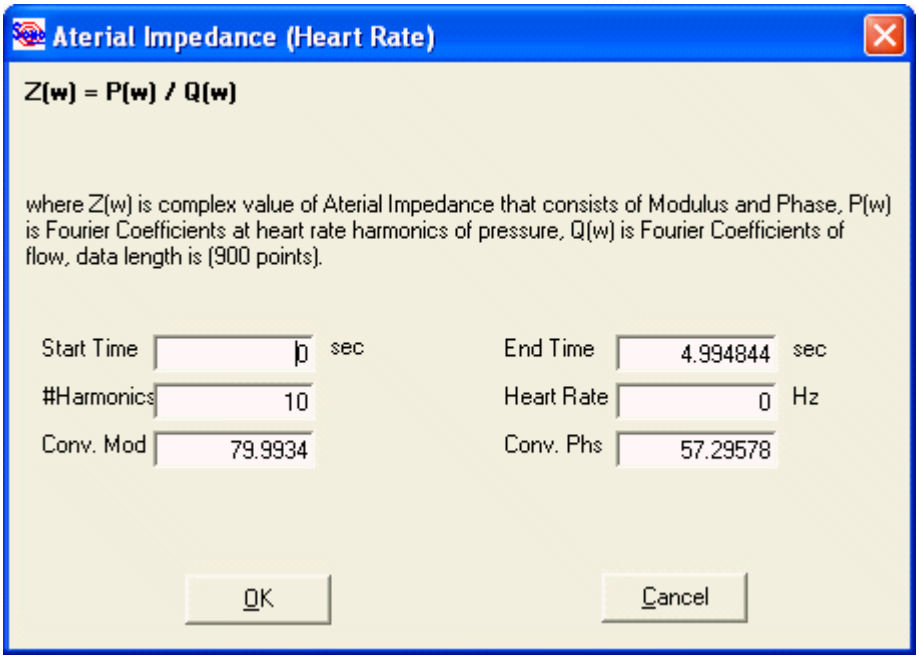
$Z(w) = P(w) / Q(w)$

Where Z(w) is the complex value of the Arterial Impedance that consists of Modulus and Phase

P(w) are the Fourier Coefficients of pressure at heart rate harmonics

Q(w) are the Fourier Coefficients of flow at heart rate harmonics

In SonoSOFT's Analysis window, the user has several parameters they can modify for the AI(H) calculations. With the appropriate Calculation radio button selected, the activation of the Equation button will bring up the following parameters window:



There are four primary parameters to consider:

1. "#Harmonics" – this field is the number of harmonics (N) to be used in the calculations. This field will accept values between 5 and 50. A value outside this range will cause the system to default to 10.

2. "Heart Rate" – this field is the user specified fundamental frequency in Hz. If this value is set to zero, the pressure wave is used to determine the fundamental pulsation rate, specifically by calculating the periodicity of the maxima. The calculated pulsation rate is display in the SonoSOFT's data grid area "Data Zone" with "Spectra" selected. It is the smallest non-zero frequency value.

   If the "Heart Rate" field set to zero and the user selects a trace region that has fewer than two pressure wave maxima, it is not possible to calculate the pulsation rate. In this case the software will default to a value of 2.0. We recommend that the "Heart Rate" field be set to an appropriate non-zero value for calculations being done on small highlighted trace regions.

3. "Conv. Mod" – this field is a number that will convert the value of the input Impedance modulus from the input units used in the calculations into the desired user units. Often the units of pressure are in mm-Hg and the units of flow are L/min. The value 79.9934 will convert the Impedance calculated in mm-Hg and L/min to dynes-sec/cm^5. Any reasonable floating-point value is acceptable in this field.

4. "Conv. Phs" – this field is a number used to convert the value of the phase angle associated with the Impedance. The value 57.2957 will convert radians to degrees. Only two possible values are currently supported, namely, 57.2957 (to degrees) and 1.0 (radians). Other values will result in the phase angle being displayed in radians.

The above-mentioned parameters are used to adjust the values displayed in "Spectra" "Data Zone" area in SonoSOFT.

Area

Area Calculations

The area calculations allow the user to derive an area associated with one or three physical dimensions. These include:

- Circular Area
- Square Area
- Triangular Area

Circular Area

Area calculation assuming a circular region

Area = pi * d * d / 4

Where d is the selected channel, taken as the diameter of the circle

Square Area

Area calculation assuming a square region

Area = d * d

Where d is the selected channnel

Triangular Area

Area calculation assuming a triangle

Area = sqrt((d1+d2+d3) * (-d1+d2+d3) * (d1-d2+d3) * (d1+d2-d3)) / 4

Where d1, d2 and d3 are the selected channels representing the lengths of the three sides of the triangle.

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