

Elbirt Technologies – Visualizer (ET-V) 1.0 Documentation

Elbirt Technologies
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I Product Specification

Product Overview

ET-V 1.0© is a Java application that visualizes and intonates multidimensional data. Visualization is in 3 dimensional coordinate space using JOGL (Gothel, 2010); a java library for OpenGL graphics. Additional visual variables include object shape, size, alpha-size, cluster value, spin, and color (RGB).

Intonation is done with the java MIDI sound library. Music variables include Note, Instrument, Channel, Velocity and Beats.

Input files are in *Microsoft Excel XLS and XLSX™* files specifically formatted as outlined in [II – Input Files](#).

About the Author / Bug Reporting / Feature Request

ET-V 1.0© is a product of Benjamin Elbirt / Elbirt Technologies. Use the following e-mail address to report bugs, request features or ask questions. Be sure to check [Appendix B – Error Debugging](#) for more information on common errors and how to collect error information.

Website: <http://www.elbirttechnologies.com>

E-mail: elbirt@elbirttechnologies.com

Minimum Hardware/Software Requirements

Microsoft Windows 32 (XP or later) or 64 bit™

Latest Java Runtime Environment in 32 or 64 bit based on the OS <http://www.java.com/>

500 MB Memory¹

Recommended Hardware/Software Requirements

Microsoft Windows 64 bit™

NVIDIA QUADRO FX 3800 or later Graphics Card

4.0 GB Memory²

Software Installation

The software is installed as part of the **Elbirt Technologies Software Suite©**. Please visit the website <http://www.elbirttechnologies.com> to obtain your copy of the software based on your operating system (32 vs. 64 bit).

Execute the installation file once downloaded and follow the provided instructions.

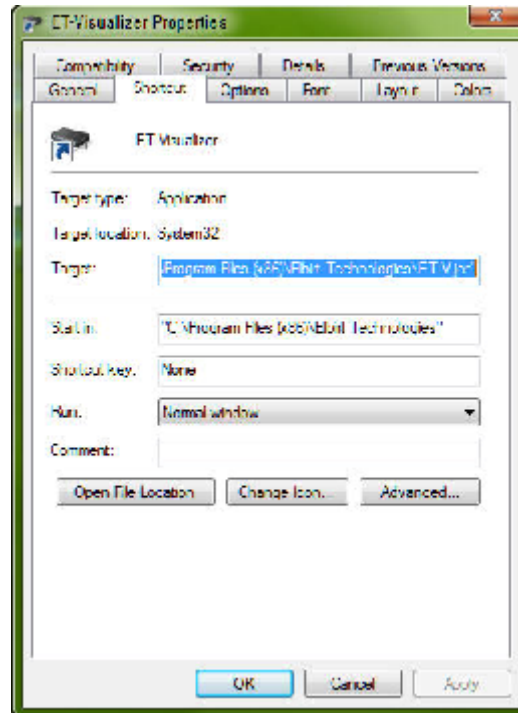
¹ Some examples provided with this software will require more memory than available with this configuration.

² Memory above 3GB requires Windows 64 bit.

Memory Expansion and Consumption

ET-V 1.0© uses the memory specified in the default java runtime environment if no options are specified. The installation provides Windows short-cut link files with the proper java execution variables for expanding the system memory. These files can be found in the installation directory (\$INSTALL_PATH) and on your Desktop if the desktop installation option was selected.

- **32 bit Windows** – C:\Program Files\Elbirt Technologies\
- **64 bit Windows** – C:\Program Files (x86)\Elbirt Technologies\



The short-cut properties can be accessed by right clicking on the short-cut and selecting "Properties" from the menu. The properties window will open and provide multiple tabs of information. Select the "Shortcut" tab; which contains the following *Target*:

C:\Windows\System32\java.exe -Djava.library.path="\$INSTALL_PATH\lib" -Xms1000M –Xmx1500M -jar "\$INSTALL_PATH\ET-V.jar"

The **–Xms1000M** specifies a minimum virtual memory setting of 1,000 MB or 1GB. The **–Xmx1500M** specifies a maximum virtual memory setting of 1,500 MB or 1.5GB. Please see [Appendix A – Memory Recommendations](#) for more information on what these values should be based on your system memory size.

You should EDIT the short-cut "Target" value to contain the proper Xms and Xmx values for your system. The **Xmx** value will need to be larger if you encounter out of memory errors.

Future Enhancements

1. **AVI/MOV Video Creation** – This will create an AVI and/or MOV file of the ET-V visual display and include your mouse movements and visual changes as they occur.
2. **Time Series Edge Display** – This option will create edges from time point to time point as a function of shared object labels when viewing a time series as a non-time series data set. The idea is to be able to track a given object's position changes over time by edge connection.
3. **Improved Input File Format** – Additional options will include:
 - i. Any order of column data for attributes
 - ii. Additional attributes not necessarily used by ET-V (but stored for your data usage)
4. **Separate Animation Timer** – This will fix the timer functionality issue described in [Animation and Intonation Processing](#).
5. **Axis Poles** – An option to have “poles” created through Sphere and Point objects to allow Spin characteristics to be visible.
6. **Text to Camera Alignment** – Rotate text so it always faces the camera upright.

II Input Files

[illegible]

Input File Types

ET-V 1.0© uses Microsoft Excel™ XLS and XLSX files as input. Each spreadsheet (yellow highlight) is considered a unique data set.

The files are always ordered from first spreadsheet to last spreadsheet and from first file to last file. Thus, two files with 2 spreadsheets each would have 4 data sets ordered 1-1, 1-2, 2-1, and 2-2 where 1-1 is file 1 spreadsheet 1.

Input File Format

Each spreadsheet **must** be formatted exactly as specified below or an error will be generated when attempting to load the data file.

The first line should always be the column label line (green highlight). Although the current file currently requires all columns be provided in the specific order shown, future enhancements will include the ability to have any column label order and columns not used by the application.

The data can be broken into two main groups; object attributes (blue highlight) and object edges (magenta highlight).

Object Attributes

7	NEWFOUNT	-105 8772	43 1313	-101 1022	46	46	0 5 down	0	1	0	68	0	0	55	1	1
---	----------	-----------	---------	-----------	----	----	----------	---	---	---	----	---	---	----	---	---

The attributes (blue highlight) **must** always come before the edges. Each object attribute row will contain the following attributes in the specific order provided:

1. **Label** – This is the object label for display.
2. **Crd 1** – This is the first coordinate dimension (X).
3. **Crd 2** – This is the second coordinate dimension (Y).
4. **Crd 3** – This is the third coordinate dimension (Z).
5. **Size** – This is the size of the object and must be greater than zero ($0.0 < \text{Size}$).

6. **Size Alpha** – This is the secondary size attribute used for Torus, Pyramid, Cube, and Cylinder *Shapes* as the donut size, pyramid height, cube to rectangle, and cylinder height. *Size Alpha* must be greater than zero ($0.0 < \text{Size Alpha}$).
7. **Spin X** – This controls if the object will spin about the X axis during the *Linear Interpolation Slice (LIS)* frames generated. The rate specified is the number of degrees to rotate between time points. Values can be positive and negative; however the sign only controls directionality (positive = clockwise, negative = counter clockwise). Spin is only possible with Torus, Pyramid, Cube and Cylinder object types.
8. **Spin Y** – This controls if the object will spin about the Y axis during the *Linear Interpolation Slice (LIS)* frames generated. The rate specified is the number of degrees to rotate between time points. Values can be positive and negative; however the sign only controls directionality (positive = clockwise, negative = counter clockwise). Spin is only possible with Torus, Pyramid, Cube and Cylinder object types.
9. **Spin Z** – This controls if the object will spin about the Z axis during the *Linear Interpolation Slice (LIS)* frames generated. The rate specified is the number of degrees to rotate between time points. Values can be positive and negative; however the sign only controls directionality (positive = clockwise, negative = counter clockwise). Spin is only possible with Torus, Pyramid, Cube and Cylinder object types.
10. **Shape** – This is the shape of the object and can have the value *Sphere, Point, Torus, Pyramid, Cube, or Cylinder*. Additional information provided in [Appendix E – Graphic Examples of Object Shape](#)
11. **Color R** – This is the normalized Red color value ($0.0 \leq \text{Color R} \leq 1.0$) when constructing the RGB color of the object.
12. **Color G** – This is the normalized Green color value ($0.0 \leq \text{Color G} \leq 1.0$) when constructing the RGB color of the object.
13. **Color B** – This is the normalized Blue color value ($0.0 \leq \text{Color B} \leq 1.0$) when constructing the RGB color of the object.
14. **Note** – This is the integer value representing the MIDI Note to play. Please see [Appendix D – Note and Instrument Values for Audio](#) for the available values.
15. **Instrument** – This is the integer value representing the MIDI Instrument to use when playing the *Note*. Please see [Appendix D – Note and Instrument Values for Audio](#) for the available values.
16. **Channel** – This is the channel to use when playing the *Note*. Channels are limited based on the audio components used in the computer running this application. Often, there are 16 channels numbered 0 through 15. Channels can be used to segment the various object *Notes* into channel groups.
17. **Velocity** – The strength in which the note is played. Higher velocities tend to be louder and contain static in the background as though someone slammed on the piano vs. a soft touch indicative of a lower velocity value. The minimum velocity is zero and maximum is 127 ($0 \leq \text{Velocity} \leq 127$).

18. **Cluster Value** – This is a cluster value to use with the [Master Object List Cluster Value](#) sliders. This value can be used to segment the various objects into clustered groups. The minimum value is zero ($0.0 \leq \text{Cluster Value}$).
19. **Beats** – The integer number of audio beats per LIS requiring LIS to be at least twice as large as the beats value ($\text{LIS} \geq 2 * \text{Beats}$). A beats of 4 will cause 4 tones to occur between two points in time. The minimum value is one ($1 \leq \text{Beats}$).

Object Edges

The object edges (magenta highlight) occur after the attribute data and are optional. Labels used for the edge definitions **must** correspond to the label that appears in the attribute data or an error will occur.

15	NWT	NS	38.0
----	-----	----	------

Each row containing an object edge represents a directed edge. The edge is constructed by putting the *From* label in the first column (NWT), *To* label in the second column (NS), and *Edge Strength* in the third column (38.0). Missing edge strengths are assumed to be binary and are assigned a value of 1.0. Edges must be greater than or equal to zero ($0.0 \leq \text{Edge}$); however all zero value (vs. blank/missing) edges are ignored.

GUI Updates from Data Sets Interface Changes

Upon data addition or removal from the [Data Sets Interface](#), the following GUI updates are made:

- **Main Graphic GUI Display** – This display will be updated to have a viewport and Axis that is +/- the largest absolute coordinate in size.

Coordinate Spaces that are extremely large will have their text size reduced as a function of the change in space size to the current *Font Scale* used. Enlarge the *Font Scale* slider value to make the text more visible.

- **Environment Configuration GUI** – The *Token Scale* slider maximum value will be expanded to fit the new space size and will be set to the default 1.0 Scale (no change).

Data Recommendations

The author of this application has viewed enough data sets to have come up with a few recommendations that will make the final display easier to see and more useful to the user.

Coordinate Dimensions – Coordinate dimensions determine the scale of the space; the largest absolute coordinate being the main determinant. Smaller spaces are often compact and hard to view while extremely large spaces are often too spread out and become difficult to observe as a whole. Although the author has used coordinate spaces larger than 10,000.00 it is highly recommended that spaces be contained to sizes between 500.00 and 1500.00.

Object Sizes – Object sizes can distort the display if they are proportionally wrong to the coordinate dimensionality of the space. It is highly recommended that the largest object size for a given space be $1/20^{\text{th}}$ of the largest absolute coordinate dimension. Thus, if your space is 500.00 units large the *largest object* should be $1/20^{\text{th}}$ of 500.00 or 25.00.

Object Audio – Although the audio is limited by MIDI (velocity, note, instrument) it is often important to restrict the range of the audio values. Notes that are extremely low or extremely high in value can often be inaudible unless the instrument used corresponds to such tones (ex. Bass for low tones, flute for high tones). Multiple instruments may create an interesting symphony of music, but often they will create too much mixed noise to detect any form of pattern. It is highly recommended that instrument usage be done sparingly, after repeated tests for clarity, and that notes are normalized around a value of 65 to 100³.

Data Normalization

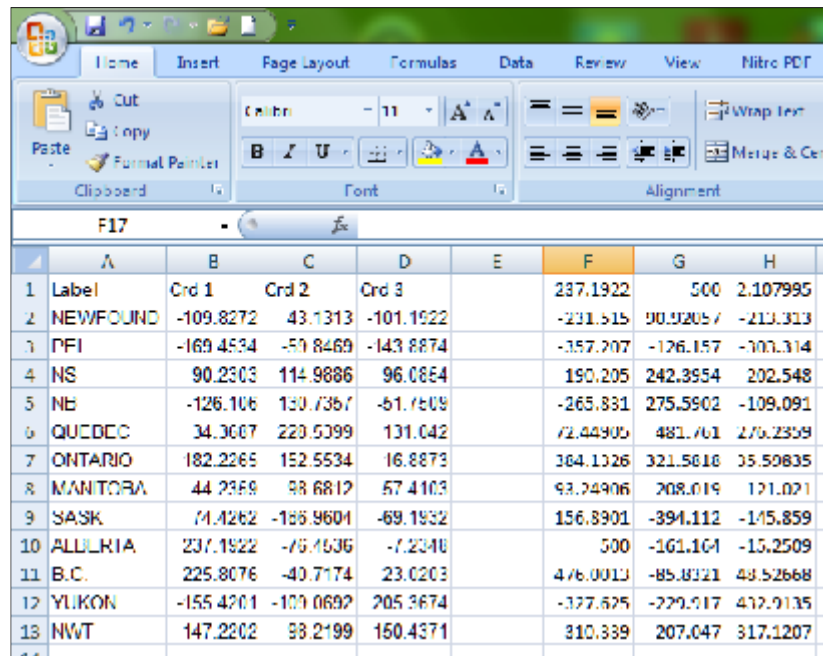
ET-V 1.0© does not internally normalize the data provided and attempts to expand to fit the needs of the data. A minimum coordinate space size of +/- 100.0 is used to prevent display problems from very small spaces.

Microsoft Excel™ provides an easy interface for normalizing data and can be used to update various elements of the input file data sets.

Normalization does not distort the data; rather it expands and contracts the data proportionally. It is important, however, to note the proportion used to ensure proper perspective is maintained by the user during the visualization.

³ This suggests that the mean value be between 65 to 100 rather than the maximum value. The maximum value can never be larger than 127 and all values **must** be in integer format.

How to Normalize the Data with Microsoft Excel™ and the ET-V 1.0© Data File



	A	B	C	D	E	F	G	H
1	Label	Ord 1	Ord 2	Ord 3		237.1922	500	2.107995
2	NEWFOUND	-109.8272	43.1313	-101.1922		-231.515	90.92057	-213.313
3	PEI	-169.4534	-59.8469	-143.8874		-357.207	-126.157	-303.314
4	NS	90.2303	114.9886	96.0854		190.205	242.3554	202.548
5	NB	-126.106	130.7367	-61.7609		-265.831	275.5902	-109.091
6	QUEBEC	34.3607	229.5399	131.042		72.44905	481.701	276.2359
7	ONTARIO	182.2265	152.5534	16.8873		164.1326	321.5616	35.59835
8	MANITOA	44.2369	98.6812	57.4103		93.24906	208.019	121.021
9	SASK	71.4262	-166.9601	-69.1932		156.8901	-394.112	-145.859
10	ALBERTA	237.1922	-76.4636	-7.2340		500	-161.161	-15.2509
11	B.C.	225.8076	-40.7174	23.0203		476.0013	-85.8321	48.52668
12	YUKON	-155.4201	-109.0692	205.3674		-377.625	-229.917	412.9135
13	NWT	147.2202	98.2199	150.4371		310.339	207.047	317.1207

Coordinate Data Normalization Excel File Example⁴

- Coordinates** – Normalizing coordinates requires determining the multiplier as a function of the largest absolute coordinate and the size of the space to normalize to. Multiplying all coordinates by the multiplier will normalize them to the space size defined while retaining their sign.

Let the largest absolute coordinate = L

Let the desired size of the space = S

Let the multiplier = M = S/L

L can be calculated with the Excel formula:

$$=MAX(MAX(B2:D13),ABS(MIN(B2:D13)))$$

B2:D13 is a reference to the three coordinate columns of data. In the case of this example there are 12 objects on rows 2 through 13. Replace D13 with D# where # is the last row number containing the attribute data. B2 will always be the start row and column with the current [input file format](#)⁵.

S is a value you define. For our example we will use 500.00 as shown in cell G1.

⁴ The input file data set has been reduced to just the coordinates for simplicity of presentation.

⁵ The reason we cannot just specify the columns B:D instead of B2:D13 is the use of columns A, B and C for the relation data. The largest absolute coordinate value would be determined using the Edge Strength values which are not intended as part of the calculation. An alternative is to temporarily remove the edge definitions in the file to do the normalization. Once normalized, put the edges back in.

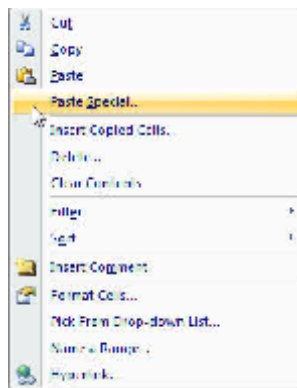
$M = S/L = 500 / 237.1922 = 2.107995$ as shown in cells *F1* and *H1*. The Excel formula use in cell *H1*:

`= (G1/F1)`

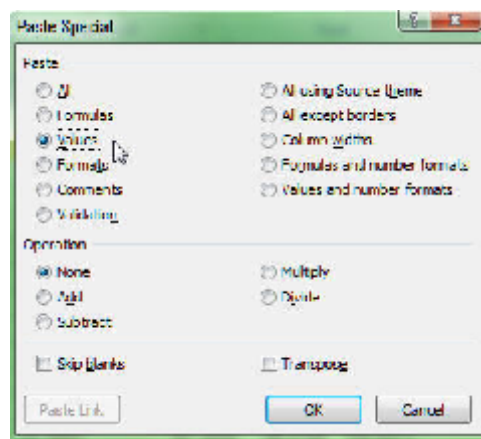
The multiplier can then be used with the coordinate data to generate the new values. The Excel formula below is put in cell *F2*:

`=B2*H1`

Cut and Paste the results in cell *F2* into cells *F2* through *H13* inclusive to have the formula applied to all the coordinate cells. Remember to substitute the *H13* with *H#* where *#* is the last row number containing the attribute data. *\$H\$1* is used to ensure that the formula always uses the cell with the multiplier in it for the multiplication.



To put the new values into the old coordinate data columns, select cells *F2* through *H13* inclusive and copy the cells. Next, click on cell *B2* and right click the mouse on that cell to get the cut and paste menu shown above. Select the *Paste Special...* option as highlighted in the graphic above. This results in the following menu:



Change the *Paste* option to *Values*. This will cause excel to paste the values copied rather than the formula in the cells. Pasting the formulas would cause an error with excel concerning formula looping.

Finally, delete the columns created to determine the new coordinates (*F*, *G* and *H*). The results should be the original data file with the new coordinates.

When using multiple spreadsheets as a time series you should always calculate the largest absolute coordinate as a function of all coordinates in all spreadsheets rather than each spreadsheet separately. This ensures that the scale changes over time are retained. Doing each sheet individually will scale the coordinates to the space ignoring the relationship of the scale in the time series.

To calculate *L* when there are the same volume of labels across all sheets use the Excel formula:

=MAX(MAX(Sheet1:Sheet3!B2:D13),ABS(MIN(Sheet1:Sheet3!B2:D13)))

Sheet1:Sheet3! is a reference to the entire list of sheets. Substitute *Sheet1* with the name of the first sheet in your data file; *Sheet3* with the name of the last sheet in your data file.

B2:D13 is a reference to the three coordinate columns of data. In the case of this example there are 12 objects on rows 2 through 13. Replace *D13* with *D#* where *#* is the last row number containing the attribute data. *B2* will always be the start row and column with the current [input file format](#)⁶.

Cases where the sheets have different object volumes requires a more complicated solution where the Largest Absolute Coordinate is calculated for each spreadsheet and then determined from the results of each spreadsheet. Thus, if *F1* is the largest absolute coordinate for a given sheet, the over-all largest value across all sheets would be:

=MAX(Sheet1:Sheet3!F1)

This value needs to be applied across all spreadsheets and can be copied, using the “Paste Special...” process described above, to all the other spreadsheets in cell *F1*. From there, the procedure is the same except the Largest Absolute Coordinate value is a function of all spreadsheets rather than each one individually.

- **Object Size / Alpha Size** – Normalizing object size and alpha size requires determining the multiplier as a function of the largest object size and the largest object size to

⁶ See the previous footnote.

normalize to. Multiplying all object sizes by the multiplier will normalize them to the object size defined.

This is the same process as shown above, however it is applied to the size columns rather than the coordinate columns and the size to normalize to will be smaller than the coordinate space size (S).

The excel formula for determining the largest absolute size L is:

`=MAX(Sheet1:Sheet3!E:F)`

Sheet1:Sheet3! is a reference to the entire list of sheets. Substitute *Sheet1* with the name of the first sheet in your data file; *Sheet3* with the name of the last sheet in your data file.

E:F refers to columns E and F which are the size and size alpha columns respectively. Full column name reference is usable here because the edge data will never use these columns.

- **Audio**

Audio normalizations are slightly more complicated as the values are all integers and thus the results of normalization have to be rounded. Follow the same procedure as the coordinates; however substitute the proper data columns. The formula to modify the existing audio value becomes:

`=ROUND(B2*H1,0)`

The *ROUND(val,precision)* function in excel rounds the value to the based on the decimals desired; in this case we specify zero (0). *B2* should be changed to the first row and the proper audio data column. *\$H\$1* should be changed to the cell that contains the multiplier generated.

III GUI Interfaces

There are 5 main GUI interfaces used to view and control the data through **ET-V 1.0©**. These are:

ET-V Main Display – This GUI provides the graphical output of the data shown with menus to clear data, exit the application, take snapshots and view the other configuration GUIs.

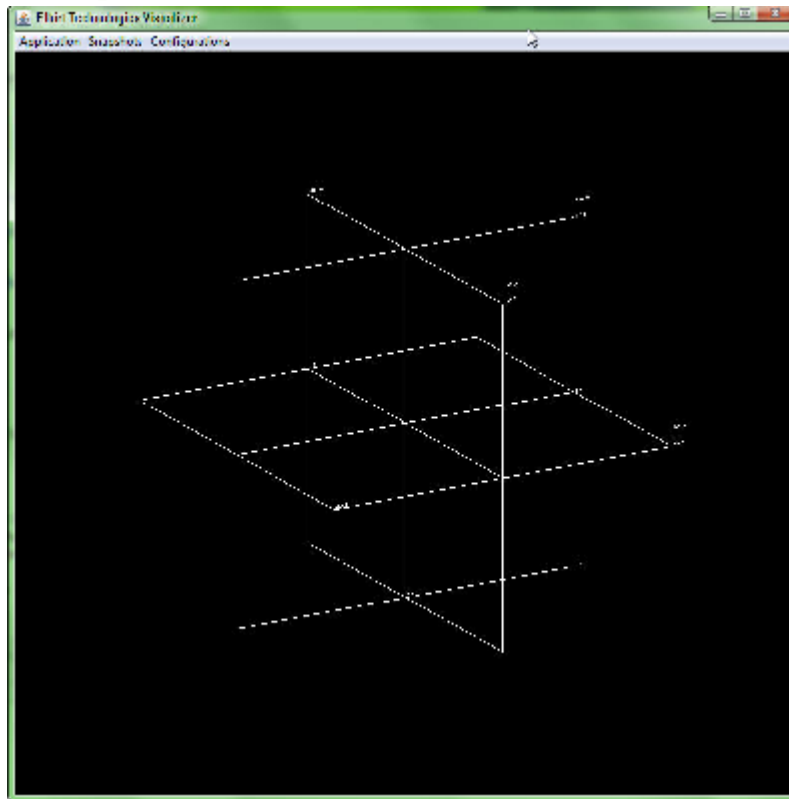
Animation / Audio Interface – This GUI provides controls related to the animation and intonation of the provided data files.

Environment Configuration – This GUI provides controls for the general display environment including font sizes, object sizes, and general visibility.

Data Set Interface – This GUI provides controls for adding, removing, re-ordering, hiding, and showing of the data.

Master Object List – This GUI provides a master list of all objects across all data sets with controls for hiding and showing the data based on cluster value, label and ego cluster settings.

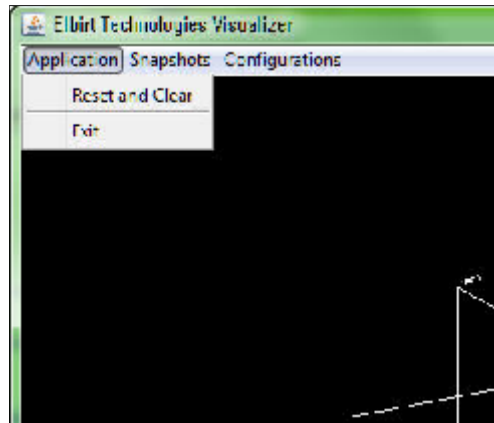
ET-V Main Display



Main GUI

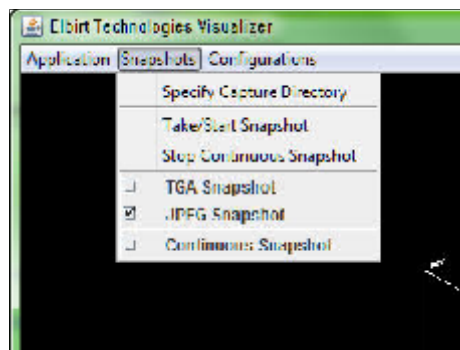
The Main GUI contains the graphical presentation environment and three menus located at the top of the window.

Application Menu



The *Application* menu provides two controls; *Reset and Clear* and *Exit*. *Exit* will close the application. *Reset and Clear* will remove all data loaded and reset the display to the default position, size, orientation and zoom.

Snapshots Menu



The *Snapshots* menu provides access to various controls and configurations for taking snapshots of the active display.

Specify Capture Directory - This option allows for the specification of the directory to place all snapshots taken into. The default directory is C:\.

Take / Start Snapshot – This option will take a snapshot of the current display or start the process of *Continuous Snapshot*.

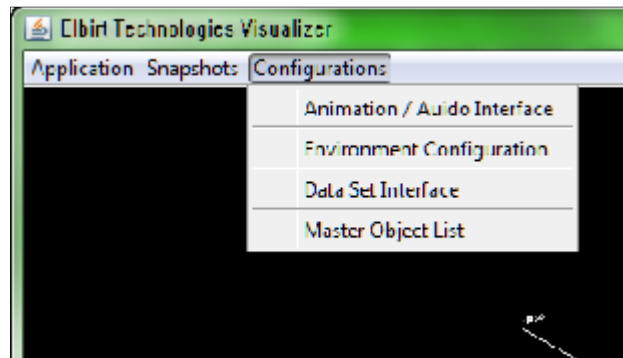
Stop Continuous Snapshot – This option will stop the recording of snapshots when using the *Continuous Snapshot* option.

TGA / JPEG Snapshot – These checkboxes allow for the type of snapshot to create. TGA, or *Truevision Graphics Adaptor*, are in widespread use due to their simplicity and ease of implementation and lack of encumbering patents (Truevision TGA, 2010).

Continuous Snapshot – This option will cause the application to create a snapshot after each frame of display created. These snapshots can be combined into a movie file by a separate program⁷.

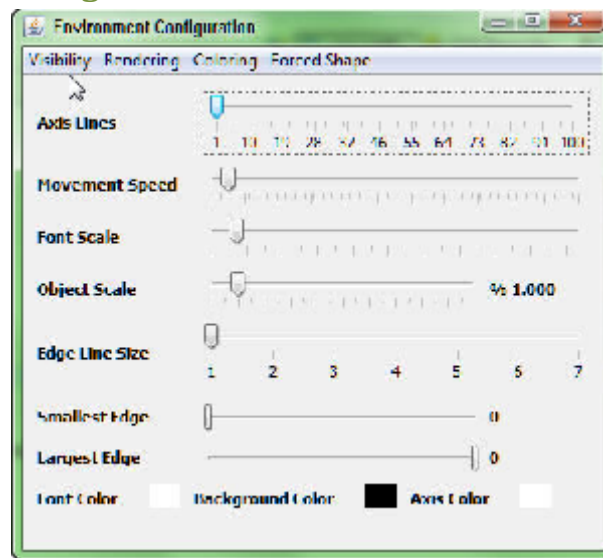
WARNING: The continuous snapshot option can create a significant number of files in a short amount of time consuming hard disk space.

Configurations Menu



The *Configurations* menu provides access to the other GUI interfaces used to control the application.

Environment Configuration



Main GUI

The *Environment Configuration* GUI contains a series of display controls with 4 menus at the top of the GUI: *Visibility* Menu, *Rendering* Menu, *Coloring* Menu and *Forced Shape* Menu. The GUI controls are defined as follows:

⁷ The author has plans to incorporate the MOV/AVI creation feature in a future release of this software. MIDI sounds will also be added to the movie file in the future release.

Axis Lines – This slider controls the number of line divisions to draw when displaying the coordinate axis. Control of which axis lines to display is found in the [Visibility Menu](#).

Movement Speed – This slider controls the rate of movement per mouse/keyboard action. Slower movement occurs when the slider is to the left; faster movement when the slider is to the right.

Font Scale – This slider controls the size (scale) of the font used to display text. Smaller sizes occur when the slider is to the left; larger sizes when the slider is to the right.

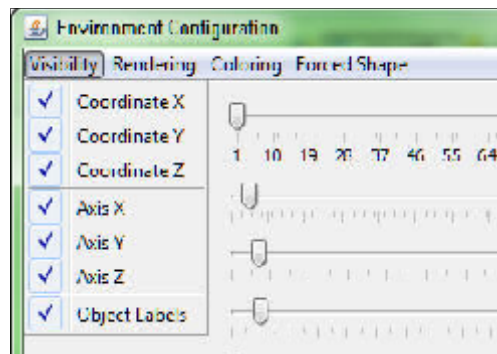
Object Scale – This slider controls the multiplier applied to the object size values. The slider provides the ability to both shrink and expand the size of objects. A numerical value for the multiplier is provided on the right of the slider to identify the current viewing scale applied to size.

Edge Line Size – This is the thickness of the lines to use when displaying edges. OpenGL limits line sizes to 7 pixels resulting in an inability to use line size as a means of displaying edge strength. Thus, the size is for visibility / visual pleasure purposes only.

Smallest Edge / Largest Edge – These two sliders control the edge value range that is visible on the GUI. Edges strengths that are larger than the *Largest Edge* and smaller than the *Smallest Edge* will not be displayed. The GUI will increase the maximum possible edge strength as data is added to the [Data Set Interface](#).

Font Color / Background Color / Axis Color – These color squares provide the active colors used for displaying the font (when not using the object color), background and axis lines. Click on the color square that corresponds to the given color to view the color selection window and change the color used.

Visibility Menu



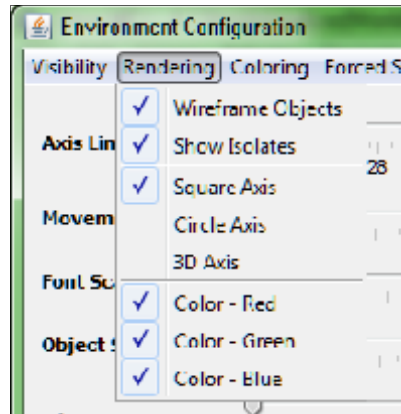
The *Visibility* menu contains checkbox on/off switches for various elements in the ET-V Main GUI Display. Those items not checked will be hidden from view.

Coordinate X / Coordinate Y / Coordinate Z – Disabling these will result in substitution of zero (0.0) values for the coordinates provided in the given dimension.

Axis X / Axis Y / Axis Z – Disabling these will hide the drawing of the given axis plane.

Object Labels – This will hide the drawing of object labels (text).

Rendering Menu



The *Rendering Menu* contains checkbox on/off switches for object specific components of the display.

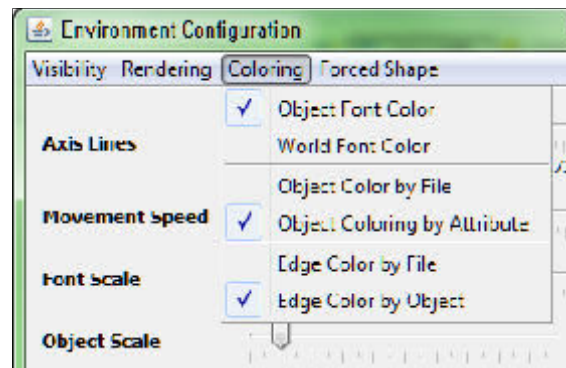
Wireframe Objects – This toggles the wireframe vs. solid object display. Wireframes tend to consume less memory and CPU for display.

Show Isolates – this option toggles the visibility of Isolates.

Square Axis / Circle Axis / 3D Axis – These checkboxes defined the type of axis to display. Only one of the three options can be specified and the 3D axis is only available as a Square Axis at this time. The number of division lines drawn for the axis is controlled by the [Environment Configuration Main GUI](#) slider *Axis Lines*.

Color – Red, Green, Blue – These options determine if the specific color value will be displayed. Those colors unchecked will have their color values replaced with zero (0.0).

Coloring Menu



The *Coloring Menu* provides options for how to generate the object and edge colors.

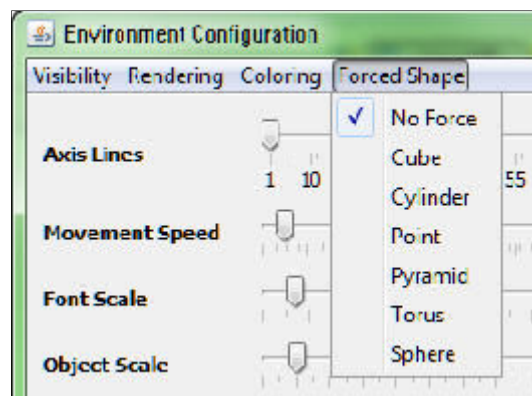
Object Font Color – This option specifies the font color used for text should be based on the color of the object it is associated with.

World Font Color – This option specifies the font color used for text should be based on the global *Font Color* setting specified in the [Environment Configuration – Main GUI](#).

Object / Edge Color by File – This option specifies the object / edge color used should be based on the XXX REF HERE from the Data Set Interface.

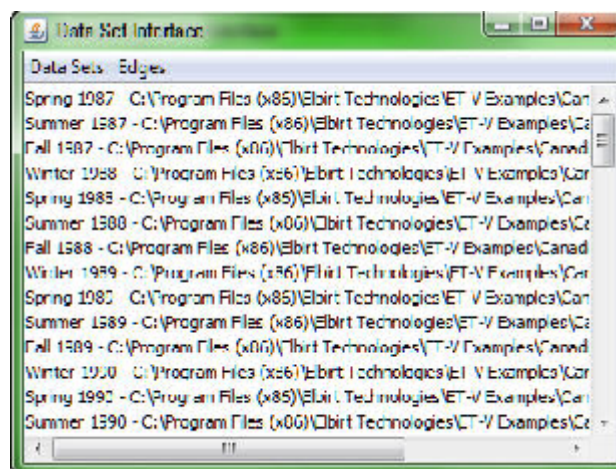
Object / Edge Color by Attributes – This option specifies the object / edge color used should be based on the color data provided in the [input file](#).

Forced Shape Menu



The *Forced Shape* menu provides options for changing the shape of all objects shown to be one of the available shapes *Cube*, *Cylinder*, *Point*, *Pyramid*, *Torus* or *Sphere*. Object shapes provided in the [input file](#) will be used when the *No Force* option is selected.

Data Set Interface

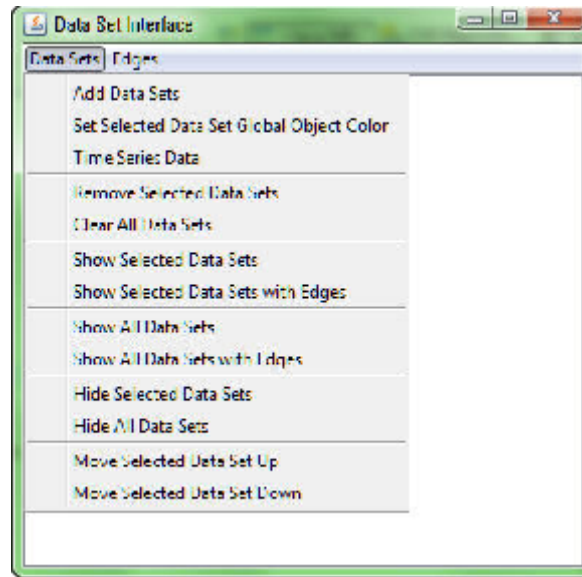


Main GUI

The *Data Set Interface* GUI contains a series of display controls with 2 menus at the top of the GUI: *Data Sets* Menu and *Edges* Menu. The main box of the GUI contains the list of loaded data

sets with the ability to select one or more data sets using the control and shift keys. The *control* key allows for single interval selection and the *shift* key allows for selection by range.

Data Sets Menu



The *Data Sets* menu provides controls for adding, removing, re-ordering, categorizing, coloring, hiding and showing data sets.

Add Data Sets – This option provides a File Selection GUI for selecting one or more **ET-V 1.0©** formatted [input files](#) to be displayed. Any errors during the load process will be in an error GUI window.

Set Selected Data Set Global Object Color – This option provides a color selection GUI for selection the default object color to use for the given data set. Blue is the initially assigned color on data load. You must have the *Object Color by File* checkbox selected on the [Environment Configuration GUI – Coloring Menu](#) for this color to be used.

Time Series Data – This checkbox, when checked, configures the **ET-V 1.0©** display to treat all data sets as a time series for animation. All objects are automatically visible unless hidden with the [Master Object List GUI](#); however only the current data set in sequence will be visible vs. all data sets simultaneously.

Unchecked data are treated as multiple data sets to view overlaid.

Remove Selected Data Sets – This menu option, when selected, removes any data sets selected from the list of loaded data sets.

Clear All Data Sets – This menu option, when selected, removes all data sets from the application memory.

Show Selected Data Sets - This menu option, when selected, makes any data sets selected visible under the limitations of the other application controls. Edges are not revealed.

Show Selected Data Sets with Edges - This menu option, when selected, makes any data sets selected visible under the limitations of the application controls. Edges are also revealed under the limitations of the application controls.

Show All Data Sets - This menu option, when selected, makes all data sets visible under the limitations of the other application controls. Edges are not revealed.

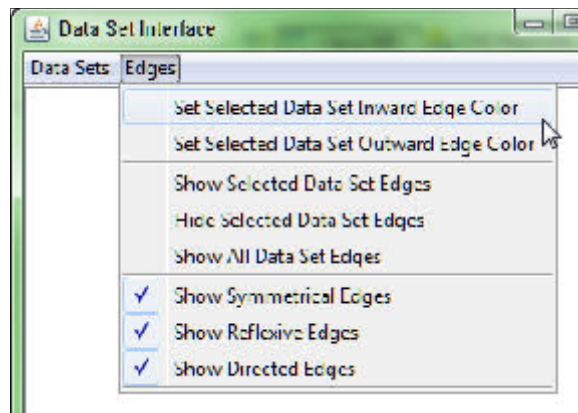
Show All Data Sets with Edges - This menu option, when selected, makes all data sets visible under the limitations of the application controls. Edges are also revealed under the limitations of the application controls.

Hide Selected Data Sets - This menu option, when selected, makes any data sets selected hidden under the limitations of the other application controls. Edges are also hidden.

Hide All Data Sets - This menu option, when selected, makes all data sets hidden including any edges associated with the data set.

Move Selected Data Set Up / Move Selected Data Set Down – These menu options will re-order the selected data sets based on the selection and the option selected.

Edges Menu



The *Edges Menu* provides edge specific controls for color and visibility.

Set Selected Data Set Inward Edge Color - This option provides a color selection GUI for selecting the default edge origination (outward) color to use for the given data set. You must have the *Edge Color by File* checkbox selected on the [Environment Configuration GUI – Coloring Menu](#) for this color to be used. Otherwise, the color will be based on the origination object color.

Set Selected Data Set Outward Edge Color - This option provides a color selection GUI for selecting the default edge termination (inward) color to use for the given data set. You must

have the *Edge Color by File* checkbox selected on the [Environment Configuration GUI – Coloring Menu](#) for this color to be used. Otherwise, the color will be based on the termination object color.

Show Selected Data Set Edges - This menu option, when selected, makes any edges associated with any data sets selected visible under the limitations of the application controls.

Hide Selected Data Set Edges - This menu option, when selected, makes any edges associated with any data sets selected hidden.

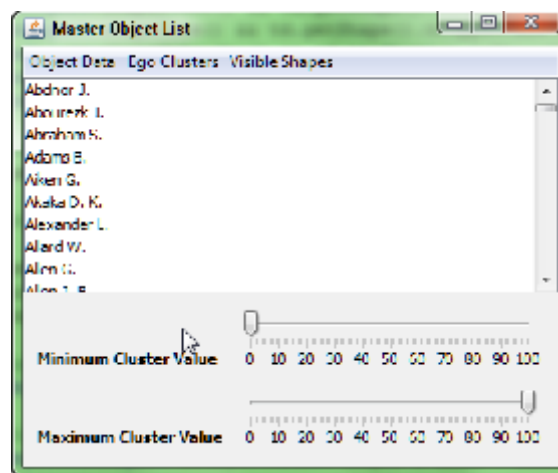
Show All Data Set Edges - This menu option, when selected, makes all edges associated with all data sets visible under the limitations of the application controls.

Show Symmetrical Edges – This checkbox option controls the visibility of edges that are [symmetrical](#). Unchecked results in the hiding of any symmetrical edges across all data sets.

Show Reflexive Edges – This checkbox option controls the visibility of edges that are [reflexive](#). Unchecked results in the hiding of any reflexive edges across all data sets.

Show Directed Edges – This checkbox option controls the visibility of edges that are [directed](#). Unchecked results in the hiding of any directed edges across all data sets.

Master Object List



Main GUI

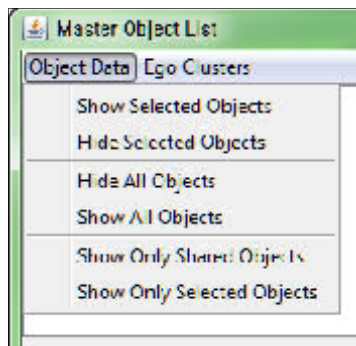
The *Master Object List* GUI contains object related display controls with 2 menus at the top of the GUI: *Object Data* Menu and *Ego Clusters* Menu. The main box of the GUI contains the master list of object labels across all loaded data sets with the ability to select one or more labels using the control and shift keys. The *control* key allows for single interval selection and the *shift* key allows for selection by range.

At the bottom of the GUI are two sliders for limiting the objects displayed by the cluster value object attribute defined in [Input Files – Input File Format](#).

Minimum Cluster Value – This value specifies the lower range limit for cluster values shown. Any object with a cluster value less than the range limit setting will be hidden from the display along with any associated edges. This applies across all data sets based on the unique data set's object cluster value.

Maximum Cluster Value – This value specifies the upper range limit for cluster values shown. Any object with a cluster value greater than the range limit setting will be hidden from the display along with any associated edges. This applies across all data sets based on the unique data set's object cluster value.

Object Data Menu



The *Object Data* Menu provides visibility options for the objects based on selection and existing edges. The hidden/visible condition of the object using this GUI does not consider other existing conditions. These existing conditions, from other GUI's and Menus, are applied after an independent check on the visibility status as defined within this GUI.

Show Selected Objects – This will unhide any objects selected from the Master Object List.

Hide Selected Objects – This will hide any objects selected from the Master Object List.

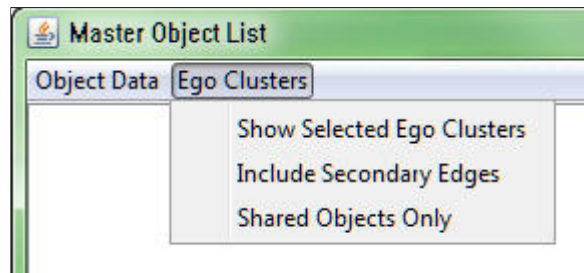
Hide All Objects – This will hide all objects.

Show All Objects – This will unhide all objects.

Show Only Shared Objects – This will show the selected objects and any additional objects that both contain a relation to. You must specify at least two objects in the Master Object List for this functionality to work.

Show Only Selected Objects – This will hide all objects other than those selected in the Master Object List.

Ego Clusters Menu



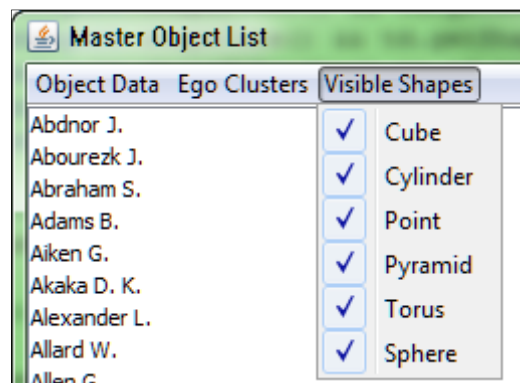
The *Ego Clusters* menu provides additional controls for object visibility based on the notion of an "[Object Ego Network](#)". The Ego Cluster of an object (i) is the set of other objects i has an edge to.

Show Selected Ego Clusters – Select (check) to activate and deselect (uncheck) to deactivate the ego clustering display methods.

Include Secondary Edges – Select (check) this option to view the edges between all objects in the Ego Cluster rather than just the edges from the Ego object i .

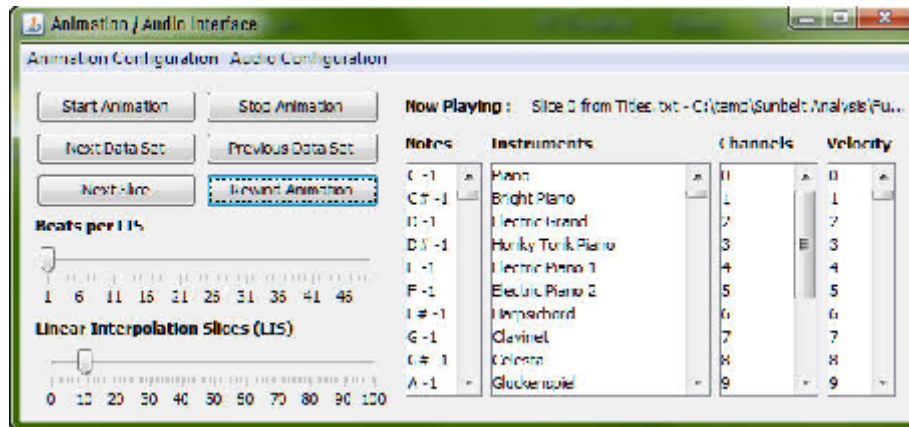
Shared Objects Only – Select (check) this option, with at least 2 objects selected from the Master Object List, to view the ego cluster formed by all selected objects $i\ 1..n$ limited to all objects shared by $i\ 1..n$. Objects that are not found in all i are not shown.

Visible Shapes Menu



The *Visible Shapes* menu provides additional controls for object visibility based on the shape of the object in the data file. Only those shapes that are checked/selected will be shown in the display. This option is ignored completely if the *Forced Shape* [environment configuration menu](#) option is selected.

Animation / Audio Interface



Main GUI

The *Animation / Audio Interface* GUI contains animation and audio controls for time series data. These controls do not apply unless the [Data Sets Interface – Data Sets Menu](#) *Time Series Data* menu item is selected (checked). Time Series data, by default, have all data set objects visible unless hidden by other constraints set in the other GUI / Menu interfaces. Edges are not visible and must be made visible through the [Data Sets Interface – Data Sets Menu](#).

Two menus, *Animation Configuration* Menu and *Audio Configuration* Menu provide additional controls for animation and audio outputs.

Forced audio values are manipulated with the *Beats per LIS* slider and four selection boxes identified as *Notes*, *Instruments*, *Channels* and *Velocity*. All audio is disabled by default. Use the *Enable Audio Outputs* option in the [Audio Configuration Menu](#) to activate audio.

Linear Interpolation Slice (LIS) – This slider controls the number of slices to generate between each data set. The more slices generated the slower and smoother the animation will appear.

Beats per LIS – This slider controls the number of tones to generate between each data set when the *Use Selected Beats per LIS* option is selected in the [Audio Configuration Menu](#).

Five buttons control the current state of the animation:

Start Animation – This button will start the animation timer running; updating the current *Linear Interpolation Slice (LIS)* for the visible data set.

Stop Animation – This button will stop the animation in the current *Linear Interpolation Slice (LIS)* for the visible data set.

Next Data Set – This button will forward the animation to the next data set at the current *Linear Interpolation Slice (LIS)*.

Next Slice – This button will forward the animation by one *LIS*. Moving beyond the *LIS* setting results in moving forward one data set (and beginning at slice 0).

Previous Data Set – This button will rewind the animation to the previous data set at the current *Linear Interpolation Slice (LIS)*.

Rewind Animation – This button will rewind the animation to the first data set first *Linear Interpolation Slice (LIS)*.

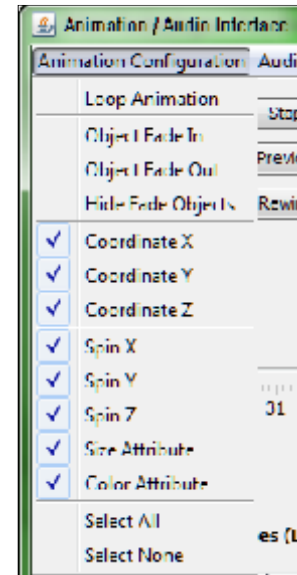
Animation Configuration Menu

The *Animation Configuration* Menu provides additional controls for the animation of time series data.

Loop Animation – Selecting this menu option will cause the animation to loop from the last data set back to the first.

Object Fade In/Out – These controls determine if the fading animation methodology is used vs. a static appearance and disappearance. Please refer to [Controlling the Main ET-V GUI Display](#) – [Animation and Intonation Processing](#) for more information.

Hide Fade Objects – This option will completely hide objects that are not shared in the current time set with the time set being animated toward. Object fade options (above) are overridden by this option.



Coordinate X, Y and Z – These control the animation of each coordinate. Objects will not move along the given coordinate during the *Linear Interpolation Slice (LIS)* frames generated unless the coordinate is selected in this menu. The object will re-locate to the next data set position as each data set is first displayed.

Spin X, Y and Z – These control if the object will spin about the X, Y and/or Z axis during the *Linear Interpolation Slice (LIS)* frames generated. The rate specified is the number of degrees to rotate between time points. Values can be positive and negative; however the sign only controls directionality (positive = clockwise, negative = counter clockwise). Spin is only possible with Torus, Pyramid, Cube and Cylinder object types.

Size Attribute – This controls if the size of the object will change during the *Linear Interpolation Slice (LIS)* frames generated. The object will re-size to the next data set value as each data set is first displayed.

Color Attribute – This controls if the color of the object will change during the *Linear Interpolation Slice (LIS)* frames generated. The object will re-color to the next data set value as each data set is first displayed.

Select All – This option will activate all other options in the menu.

Select None – This option will de-activate all other options in the menu.

Audio Configuration Menu

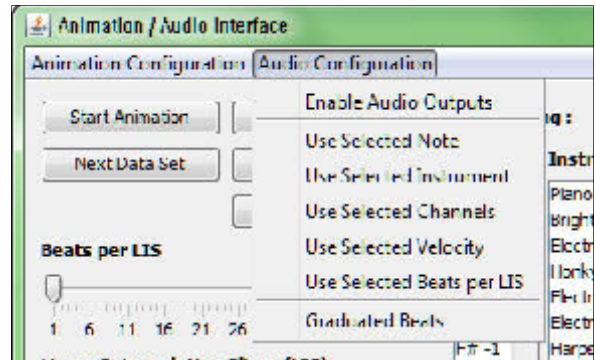
The *Audio Configuration* Menu is for enabling and disabling audio controls within the GUI.

Enable Audio Outputs – This option, when checked/selected, will enable the output of audio tones. This option must be checked to hear any audio.

Use Selected Note, Instrument, Channels, Velocity, Beats per LIS – These options will force the use of the value selected in the Animation / Audio Interface GUI instead of the value provided with each object in the [input file](#). Select the related menu item to activate and deactivate the forced value.

Graduated Beats – Audio tones normally occur on the first frame of a given data set. The next tone does not occur until either the next data set or a value greater than 1 for *Beats per LIS* is specified in the data file or forced using this GUI. In cases where the *Beats per LIS* is greater than 1 the beats are repeated without any change unless this option is selected.

This option, if selected, will increase/decrease the *Note* value based on the change between data sets in the time series. This results in a graduation of the sound (increase or decrease) vs. a continuous repeat of the same tone.



IV Controlling the Main ET-V GUI Display

Space Size from Coordinates

The viewer is currently designed to expand the axis and viewing area based on the largest absolute coordinate across all data sets. A minimum space size of 100.0 is used when the largest absolute coordinate across all data sets is less than 100.0.

Larger spaces will consume more CPU/Memory to generate, but are useful when object size and the number of objects is also large. Refer to [Input Files – Data Normalization](#) for methods to change the space and object size if the space is too large or small to be viewed properly.

Movement through the Space

ET-V 1.0© provides both mouse and keyboard controls for shifting, rotating and zooming through the data space. The rate of motion is affected by the [Environment Configuration Movement Speed](#) slider and can also be changed with the keyboard controls.

The mouse and keyboard controls only work when the [ET-V Main Display](#) is the active window.

Mouse Controls

- **Left Button** – The space will rotate when holding the left mouse button and moving the mouse.
- **Right Button** – The space will shift up/down and left/right when holding the right mouse button and moving the mouse.
- **Center Mouse Wheel** – The space will zoom in / out when scrolling the center mouse wheel.

Keyboard Controls

- **Left, Right, Up and Down Arrow** – These keys will rotate the space left, right, up and down respectively. This is the same as moving the mouse while holding the left mouse button.
- **Backspace** – This key will reset the display to be the initial viewpoint of the space on application launch.
- **C** – This key will center the data space.
- **F and S** – These keys will make the movement speed faster and slower respectively.
- **U, D, L and R** – These keys will move the space up, down, left and right respectively. This is the same as moving the mouse while holding the right mouse button.
- **A and Z** – These keys will zoom the space away (outward) or toward the center (inward) respectively.
- **Escape** – This key will exit the application.

Non Time-Series Display Processing

ET-V 1.0 current utilizes a timer method to automatically redraw the display at a rate of 18 frames per second⁸. Each frame is generated based on the display configurations controlling object and edge visibility for each data set loaded.

Animation and Intonation Processing

A separate timer for updating the current data display has not been implemented with **ET-V 1.0** because of the complexity involved in having two interdependent timers; the GUI timer and the Animation timer.

The GUI timer needs to run as fast as possible to ensure change requests are instantly processed including motion and keyboard controls. Animation requires the animation timer work on a regular interval basis. Keeping the two timers in sync so display doesn't hold up a change in data set and the data sets don't hold up the display change requests has proven too difficult for the current revision of the application. This is especially true when displaying large amounts of objects and edges simultaneously.

The current animation process uses the Linear Interpolation Slices (LIS) value to both control speed and make the animation smooth. A larger LIS value will slow the animation *and* make it smoother.

Linear Interpolation Animation is the sequencing process for the animation. Each *slice* of the animation is determined as a function of the current data set (time 1) and the next data set (time 2). The differences in values from the two points in time are used to create a slope of change which is then divided by the LIS value specified on the [Animation / Audio Interface](#). The final value is then multiplied by the current time slice value and added to the first data set value (time 1).

Audio tones are played based on the Beats per LIS defined in the [Animation / Audio Interface](#). Each tone is played when each data set first appears (Beats = 1, Current Slice = 0) and will play during the Linear Interpolation if the Beats setting is greater than 1. Beats per LIS that do not evenly distribute for the LIS setting will be skipped. Thus, with an LIS of 10 and a Beats per LIS of 3 the tones shall occur on Current Slice 0, 3, 6 skipping the tone on 9 (a fourth tone). An LIS of 20 will result in the tones on 0, 7, and 14.

Fade In / Fade Out of Objects

The current animation methodology allows for objects to exist in one point in time but not others. There are three options for how to display this phenomena; fading, static change or hidden. These options can be enabled or disabled through the [Animation / Audio Interface](#) configuration menu.

⁸ Large data sets and displays with large volumes of objects will reduce the FPS if they require large amounts of time to prepare and generate.

Fading *in* means that objects in the next data set of the time series will slowly appear during the animation. The initial color of the object will be the background color which will gradually change into the object color. Position and object size are static at the values of the data set being faded into. Turn this option off if you only want the objects to appear at the start of their data set display (static).

Fading *out* means that objects in the current data set that are not in the next data set will fade into the background by color. Size and position of the object will not change. Turn this option off if you want the objects to remain completely visible until the next data set (static).

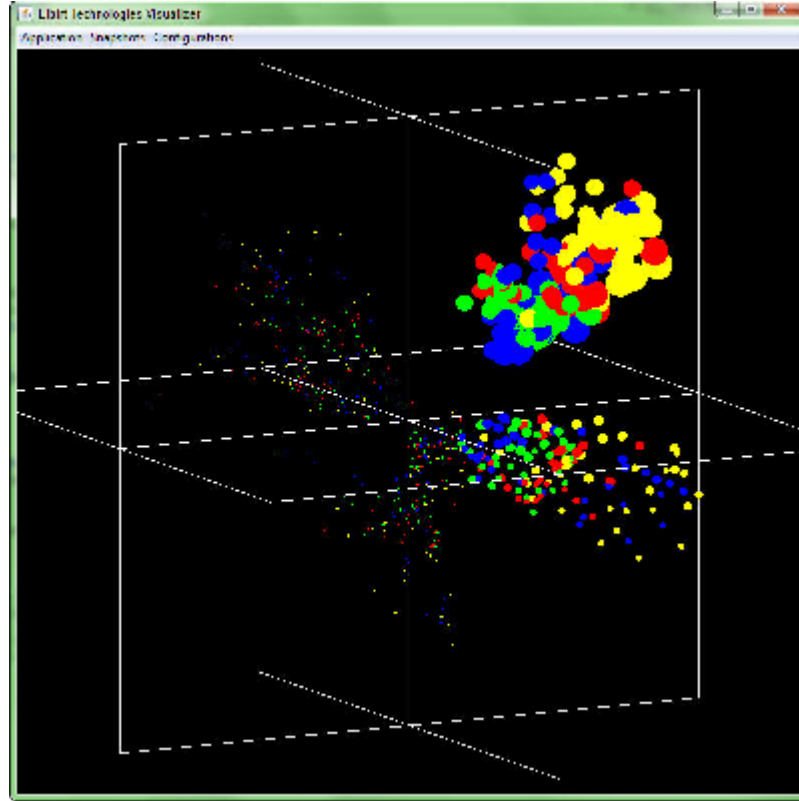
Hidden results in all objects that do not appear in the current and next data set of the time series sequence not appear at all. This option will override any fading options specified.

Object spin and audio tones are always a function of the Time 1 data set being sliced and are not affected by fade in and fade out. Objects that do not appear until Time 2 will not spin or have the audio played until that data set is the active data set. Objects not displayed will not have their audio tones played.

V Examples

Canadian Migration Patterns among Provinces

C:\Program Files (x86)\Elbirt Technologies\ET-V Examples\Canadian Migration Data.xlsx



All data non-time series solid objects with Labels disabled.

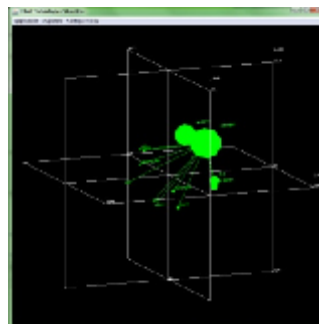
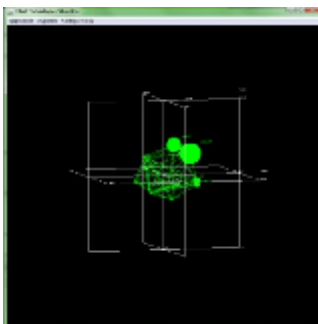
This data represents the migration of people from one Canadian province (object) to another, quarterly, for spring 1987 through spring 2005 inclusive (Barnett & Sung, 2003). The colors used are representative of the season (winter=blue, spring=green, summer=red, fall=yellow). 73 points in time are represented in a single space with 15 objects per matrix. Object size represents population. The example file includes audio tones representative of the mean migration volume across all objects in a given point in time.

The following illustrate the animation sequence using a single snapshot for each point in time. The first four points in time are displayed where the column to the right contains the *Ontario Ego Cluster* and the column to the left contains the entire data set with all edges for the same time points.

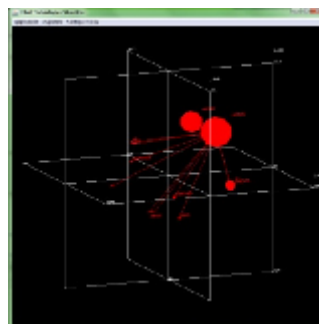
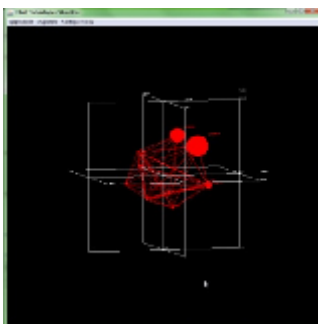
Full Data with Edges

Ontario Ego Cluster

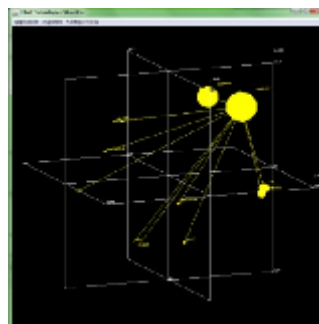
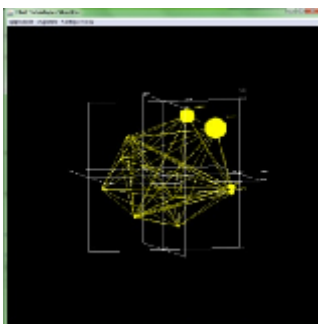
Spring 1987



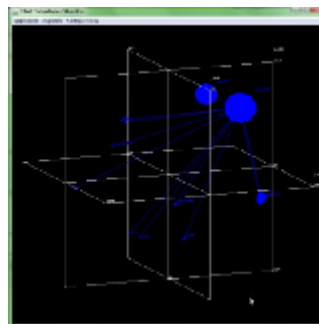
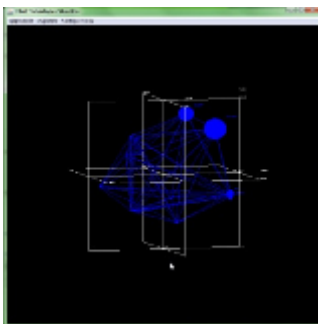
Summer 1987



Fall 1987

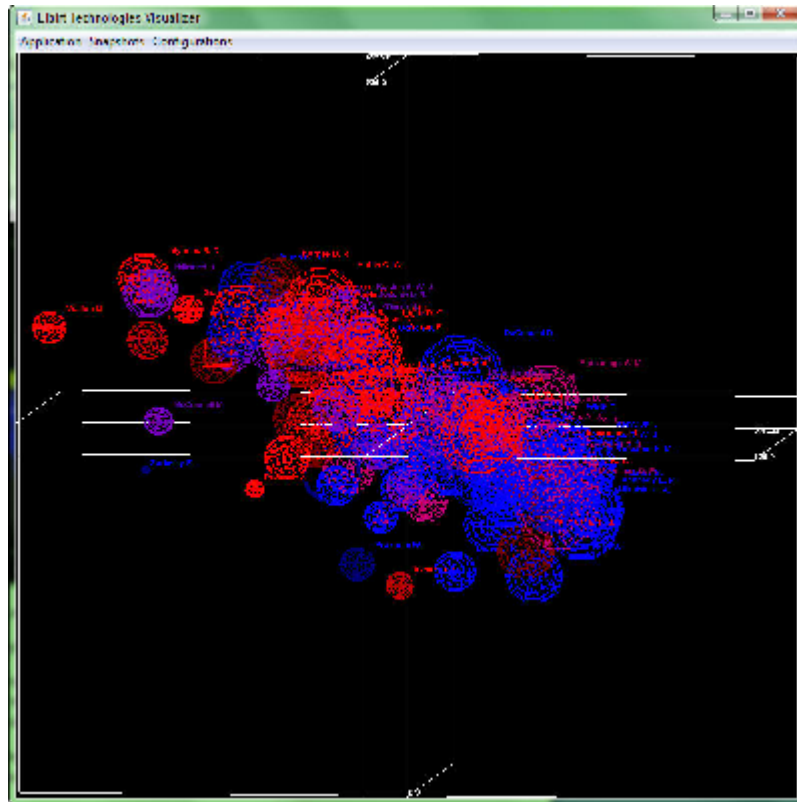


Winter 1998



US Senate Voting Patterns

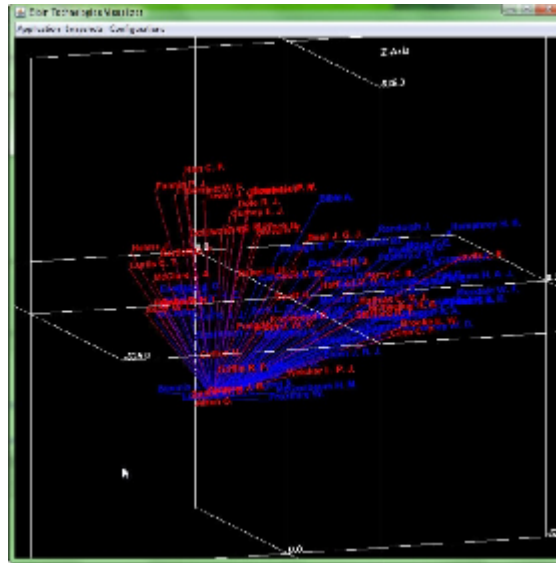
C:\Program Files (x86)\Elbirt Technologies\ET-V Examples\James Fowler Senate Data.xlsx



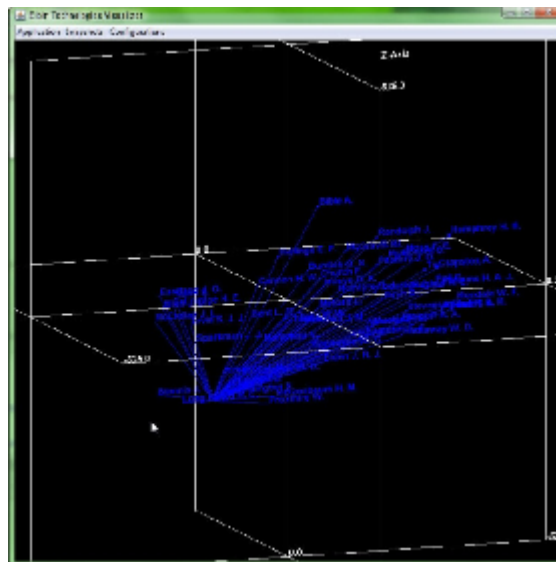
100th Congress – Wireframe with Labels no Edges – 37th Slice of 50

The data represents the co-sponsorship of bills among congressional senators from the 93rd to the 109th US Congress (Fowler, 2006) (Fowler, Cosponsorship Network Data Page, 2010). Democrats are colored blue, republicans red and independents yellow. Spheres represent regular senators and non-sphere objects represent leadership members.

This data, when animated, will show fade in/out as Senators come and go from congress. Further, party changes are visible as purple (blue to red / red to blue) during the animation and in the image provided above.



Senator R. C. Byrd, 93rd Congress – Ego Cluster with Republicans & Democrats Only



Senator R. C. Byrd, 93rd Congress – Ego Cluster with Democrats Only

The two graphics above represent the Ego Cluster of Senator R. C. Byrd during the 93rd Congress. A unique *Cluster Value* was assigned to each object based on their party affiliation. Cluster limits were imposed on the lower picture using the [Master Object List](#) GUI.

VII Bibliography

Barnett, G. A., & Sung, E. J. (2003). An examination of Canada's Interprovincial Networks. *Sunbelt Social Networks Conference*. Cancun, Mexico.

Fowler, J. H. (2006). Connecting the Congress: A Study of Cosponsorship Networks. *Political Analysis* , 14 (4), 456-487.

Fowler, J. H. (2010, September 22). *Cosponsorship Network Data Page*. Retrieved October 4, 2010, from James H. Fowler Cosponsorship Network Data Page: <http://jhfowler.ucsd.edu/cosponsorship.htm>

Gothel, S. (2010). *JOGL - Java Open Bindings for OpenGL*. Retrieved October 5, 2010, from JogAmp: <http://jogamp.org/jogl/www/>

Truevision TGA. (2010, August 20). Retrieved October 5, 2010, from Wikipedia: http://en.wikipedia.org/wiki/Truevision_TGA

Appendix A – Memory Recommendations

The following are memory recommendations based on physical memory available in the computer and are applicable to both 32 and 64 bit operating systems. The application has a minimum memory requirement of roughly 100 MB and will require more memory as data and display complexity increase.

System Memory	Minimum Value	Max Value
1000 MB (1 GB)	250M	500M
2000 MB (2 GB)	500M	1000M
3000 MB (3 GB)	1000M	1500M
> 3000 MB (more than 3 GB)	1000M	(½ Total Memory)

Example 6GB System Memory:

6000 MB	1000M	3000M
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It is important to note that disk memory and memory paging allows for growth beyond the physical memory volume of the system. Experiment with the various values until you find a setting that provides the best results.

Appendix B – Error Debugging

The following are known issues and resolutions as well as a method for the collection of bug error information for reporting.

How to view error messages and report a bug/problem

Errors that occur when using the short-cut method of application execution are not visible. To view the error messages open a DOS command window. Cut and paste the short-cut *Target* into the DOS window to execute the program and view error messages.

Catastrophic Failure - Application Auto Termination

1. The application immediately closed when I attempted some action.

There are many reasons an application will terminate; often the result of a code error or circumstance not foreseen by the developer and performed by the user. The following are a few known causes and solutions.

- a. **Memory Related Error** – The application retains all the information provided in the input file data sets in memory for use while requiring a block of memory to function on its own (roughly 350 MB). *Any attempt to use more memory than is available will automatically terminate the application.*

This often occurs when loading a data set, initially starting the application, adding more functionality to the output (audio, edges, simultaneous data sets), enlarging display characteristics and so forth.

Often, the error message provided by the Java Virtual Machine is something like:

Exception in thread "Thread-4" java.lang.OutOfMemoryError: Java heap space

To repair this problem first attempt to [alter the Short-Cut](#) provided with the application to increase the Java Virtual Machine memory allocation. You will need to add more physical memory to your computer if the problem persists and the maximum memory allowed is used by the Java Virtual Machine.

- b. **Platform (32 vs 64 bit) Errors**

Exception in thread "main" java.lang.UnsatisfiedLinkError: C:\Program Files (x86)\Elbirt Technologies\lib\jogl.dll: Can't load AMD 64-bit .dll on a IA 32-bit platform.

This error, or something similar, results from having the wrong Java / OS combination for the installed version. Make sure you are using a 64 bit OS with 64 bit Java on 64 bit systems⁹.

⁹ Apparently the 32 bit version of Java can also be installed on 64 bit systems.

- c. **Data Load File Selection Halt** – I tried to add data sets and the File Selection GUI hangs up when I try to select a large group of files, or some sub-group of files in a directory.

Unfortunately this has occurred a few times during development and the reason is not clear to the developer. Often adding the files in smaller groups will work adding a few extra steps to the process.

Problems with Data Sets

1. **My data file loads, but nothing appears in the Main ET-V GUI other than the axis!**

All data loaded have the objects and edges set to hidden. This prevents large data sets from loading all at once when they would not otherwise be displayed this way.

The only exception is when the *Time Series* option is checked in the [Data Sets Menu](#) from the [Data Sets Interface](#). Time Series data sets do not hide their objects unless these objects are hidden using the [Master Object List GUI - Object Data Menu](#).; however edges are hidden by default¹⁰.

Review the information provided on the [Data Sets Menu](#) from the [Data Sets Interface](#) for controls to unhide the data.

2. **I keep getting an error “Label Attributes not Found” even though I have the attributes in the data file.**

Object Labels are case sensitive. Spelling errors, blanks, tabs, and all other characters influence the label. Your labels must match exactly from attribute to relation pair or this error will appear. Check the data line mentioned in the error for spaces and tabs; these often end up being the problem.

3. **My data file loads, but I cannot see any of the text.**

Try increasing the *Font Scale* slider value in the [Environment Configuration – Main GUI](#). Often the problem is that the scale is set too small for the data space.

Should the text not show at the maximum scale value try normalizing your input data to a smaller space size based on the information provided in [Data Normalization](#).

4. **My data file loads, but everything seems really compact.**

A compact display results from one or more data sets having a wide data spread while others are more highly compact in comparison. The largest coordinate based spread determines the size of the space as a whole creating the compact issue.

Try normalizing your input data to a larger space size based on the information provided in [Data Normalization](#).

¹⁰ This reduces CPU load and Memory consumption.

5. **My data file loads, but all the objects are too big or too small.**

Try reducing the *Token Scale* slider value in the [Environment Configuration – Main GUI](#). Often the problem is that the object sizes cause overlap and need to be proportionally reduced for visibility purposes.

Problems with Application Response

1. **Application Appears to Hang when Processing**

This usually results from a memory availability error. To be sure, open the *Windows Task Manager* and find the *javaw.exe* reference. Check the memory being used and consider the value against the settings used in your [short-cut](#). The number may be very close or larger than the value set; an out-of-memory error.

2. **I have loaded the data and made visible the desired objects and data sets and the application windows are very slow to respond.**

The configuration for the current display is using so much memory and CPU to generate that the other windows have to wait for their turn to be available. The only no-cost solution is to reduce the amount of information you are trying to display simultaneously.

Use the *Hide All Data Sets* option in the [Data Sets Interface](#) to quickly hide all data and reduce the CPU/Memory load without having to restart the application.

Cost based solutions include purchasing a better video card for OpenGL processing and/or increase the memory available in your computer¹¹.

Problems with Animations

1. **My animation flies across the screen and then just stops.**

Adjust the [Animation / Audio Interface](#) LIS slider increasing the value. This will slow things down considerably.

2. **My animation seems choppy; as though some data sets are generating faster than others.**

The current algorithm for generating data sets based on the current time slice attempts to be as fast as possible and has been tested for processing time variations on different data sets. Tests have shown that adjusting the [Animation / Audio Interface](#) LIS slider value can help reduce lag issues that occur when generating the data set slices. A slower animation will often have a more even CPU time to display than a faster one.

The long term solution to this problem is the separate Animation Timer as discussed in [Controlling the Main ET-V GUI Display - Animation and Intonation Processing](#).

¹¹ This assumes you are already using the maximum available and have updated your short-cuts to launch java with the proper memory settings.

Problems with Audio

1. The audio plays but has a lot of static in it. What can I do to reduce the noise?

The *Velocity* of the note is often the reason for static; a setting that is too high can result in a lot of noise on the *Note*. Try using the [Animation / Audio Interface Use Selected Velocity](#) feature with different *Velocity* values until you find the audio corrected.

Appendix C – Glossary

Beats – The number of audio beats per LIS requiring LIS to be at least twice as large as the beats value ($LIS \geq 2 * Beats$). A beats of 4 will cause 4 tones to occur between two points in time.

Channel – Audio can be split among different tracks, each of which is assigned a channel ID. The channel can be limited as defined in [Animation / Audio Interface – Audio Configuration Menu](#).

Cluster Value – A numerical value greater than or equal to zero ($0 \leq Cluster Value$) associated with a given object to allow additional clustering with the [Master Object List](#) GUI.

Colors – The normalized ($0.0 \leq Color \leq 1.0$) Red, Green and Blue value for the RGB color to assign to objects, fonts, the background, the axis and the edges.

Coordinates – The X, Y and Z position in Euclidean geometric spaces to place the object.

Data Set – A single set of display data including objects, their attributes and their relations.

Data Space – The visual space containing all data set visualizations; the [Main Application GUI](#).

Directed Edge – An edge that passes from one object i to another object j without an edge from j to i or vice versa.

Edge – A relationship, represented by a line, between two objects. Edges can be symmetrical, directed and/or reflexive.

GUI – Graphical User Interface – this is the window displayed to the user and often handles user inputs.

Input File – One or more Microsoft Excel™ XLS or XLSX files containing one or more spreadsheets. Each spreadsheet contains a single Data Set as defined in [Input Files – Input Format](#).

Instrument – The MIDI instrument id used to intonate an object as defined in [Appendix D – Note and Instrument Values for Audio](#).

Isolates – Objects without edges displayed to or from other objects.

JVM – Java Virtual Machine - a piece of software that is responsible for running Java programs.

Label – The name associated with an object. Labels affect the animation process as defined in [How Animations and Intonations are Processed](#); the [Master Object List](#) is generated as a function of the unique labels across all data sets.

Linear Interpolation Animation – The process of animation that determines a linear slope between data values for two points in time and uses said slope to generate additional data sets for display. These additional data sets represent the transition between two points in time and are displayed as such.

LIS (Linear Interpolation Slices) – The number of animation frames to generate for each point in time. An LIS of 10 will result in 9 additional frames being generated to simulate the linear change between two points in time.

Note – The audio tone to be generated using the given *channel*, *instrument*, *velocity* and *beats* as defined in [Appendix D – Note and Instrument Values for Audio](#).

Object – Any single element to be displayed. Attributes include *Shape*, *Coordinates X, Y and Z*, *Colors R, G and B*, *Size*, *Size Alpha*, *Spin X, Y and Z*, *Cluster Value*, *Note*, *Instrument*, *Channel*, *Velocity*, *Beats* and *Label*.

Object Ego Cluster – A collection of objects and their relations to each other as a function of one or more specific objects and their relations. The Ego Cluster of an object (*i*) is the set of other objects *i* has an edge to.

Reflexive Edge – An edge that passes from one object *i* to itself *i*. Edges such as these can represent an internal relationship value.

Shape – The shape of an object. Shape options include sphere, torus, cylinder, pyramid, cube or point. Additional information provided in [Appendix E – Graphic Examples of Object Shape](#).

Size, Size Alpha – These are the size values ($0.0 < \text{Size}, \text{Size Alpha}$) associated with the object. Size Alpha is used for Torus, Pyramid, Cube, and Cylinder *Shapes* as the donut size, pyramid height, cube to rectangle, and cylinder height.

Spin X, Y and Z – These control if the object will spin about the X, Y and/or Z axis during the *Linear Interpolation Slice (LIS)* frames generated. The rate specified is the number of degrees to rotate between time points. Values can be positive and negative; however the sign only controls directionality (positive = clockwise, negative = counter clockwise). Spin is only possible with Torus, Pyramid, Cube and Cylinder object types.

Symmetrical Edge – An edge that passes from one object *i* to another object *j* with an edge from *j* to *i*.

Time Series Data Set – Two or more *Data Sets* that are related by way of time. The interval of time is arbitrary to the data set.

Velocity – The strength in which the note is played. Higher velocities tend to be louder and contain static in the background as though someone slammed on the piano vs. a soft touch indicative of a lower velocity value.

Appendix D – Note and Instrument Values for Audio

Notes

ID	Note
0	C -1
1	C# -1
2	D -1
3	D# -1
4	E -1
5	F -1
6	F# -1
7	G -1
8	G# -1
9	A -1
10	A# -1
11	B -1
12	C 0
13	C# 0
14	D 0
15	D# 0
16	E 0
17	F 0
18	F# 0
19	G 0
20	G# 0
21	A 0
22	A# 0
23	B 0
24	C 1
25	C# 1
26	D 1
27	D# 1
28	E 1
29	F 1
30	F# 1
31	G 1
32	G# 1
33	A 1
34	A# 1
35	B 1
36	C 2

ID	Note
37	C# 2
38	D 2
39	D# 2
40	E 2
41	F 2
42	F# 2
43	G 2
44	G# 2
45	A 2
46	A# 2
47	B 2
48	C 3
49	C# 3
50	D 3
51	D# 3
52	E 3
53	F 3
54	F# 3
55	G 3
56	G# 3
57	A 3
58	A# 3
59	B 3
60	C 4
61	C# 4
62	D 4
63	D# 4
64	E 4
65	F 4
66	F# 4
67	G 4
68	G# 4
69	A 4
70	A# 4
71	B 4
72	C 5
73	C# 5

ID	Note
74	D 5
75	D# 5
76	E 5
77	F 5
78	F# 5
79	G 5
80	G# 5
81	A 5
82	A# 5
83	B 5
84	C 6
85	C# 6
86	D 6
87	D# 6
88	E 6
89	F 6
90	F# 6
91	G 6
92	G# 6
93	A 6
94	A# 6
95	B 6
96	C 7
97	C# 7
98	D 7
99	D# 7
100	E 7
101	F 7
102	F# 7
103	G 7
104	G# 7
105	A 7
106	A# 7
107	B 7
108	C 8
109	C# 8
110	D 8

ID	Note
111	D# 8
112	E 8
113	F 8
114	F# 8
115	G 8
116	G# 8
117	A 8
118	A# 8
119	B 8
120	C 9
121	C# 9
122	D 9
123	D# 9
124	E 9
125	F 9
126	F# 9
127	G 9

Instruments

ID	Description
0	Piano
1	Bright Piano
2	Electric Grand
3	Honky Tonk Piano
4	Electric Piano 1
5	Electric Piano 2
6	Harpsichord
7	Clavinet
8	Celesta
9	Glockenspiel
10	Music Box
11	Vibraphone
12	Marimba
13	Xylophone
14	Tubular Bell
15	Dulcimer
16	Hammond Organ
17	Perc Organ
18	Rock Organ
19	Church Organ
20	Reed Organ
21	Accordion
22	Harmonica
23	Tango Accordion
24	Nylon Str Guitar
25	Steel String Guitar
26	Jazz Electric Gtr
27	Clean Guitar
28	Muted Guitar
29	Overdrive Guitar
30	Distortion Guitar
31	Guitar Harmonics
32	Acoustic Bass
33	Fingered Bass
34	Picked Bass
35	Fretless Bass
36	Slap Bass 1

ID	Description
37	Slap Bass 2
38	Syn Bass 1
39	Syn Bass 2
40	Violin
41	Viola
42	Cello
43	Contrabass
44	Tremolo Strings
45	Pizzicato Strings
46	Orchestral Harp
47	Timpani
48	Ensemble Strings
49	Slow Strings
50	Synth Strings 1
51	Synth Strings 2
52	Choir Aahs
53	Voice Oohs
54	Syn Choir
55	Orchestra Hit
56	Trumpet
57	Trombone
58	Tuba
59	Muted Trumpet
60	French Horn
61	Brass Ensemble
62	Syn Brass 1
63	Syn Brass 2
64	Soprano Sax
65	Alto Sax
66	Tenor Sax
67	Baritone Sax
68	Oboe
69	English Horn
70	Bassoon
71	Clarinet
72	Piccolo
73	Flute

ID	Description
74	Recorder
75	Pan Flute
76	Bottle Blow
77	Shakuhachi
78	Whistle
79	Ocarina
80	Syn Square Wave
81	Syn Saw Wave
82	Syn Calliope
83	Syn Chiff
84	Syn Charang
85	Syn Voice
86	Syn Fifths Saw
87	Syn Brass and Lead
88	Fantasia
89	Warm Pad
90	Polysynth
91	Space Vox
92	Bowed Glass
93	Metal Pad
94	Halo Pad
95	Sweep Pad
96	Ice Rain
97	Soundtrack
98	Crystal
99	Atmosphere
100	Brightness
101	Goblins
102	Echo Drops
103	Sci Fi
104	Sitar
105	Banjo
106	Shamisen
107	Koto
108	Kalimba
109	Bag Pipe
110	Fiddle

ID	Description
111	Shanai
112	Tinkle Bell
113	Agogo
114	Steel Drums
115	Woodblock
116	Taiko Drum
117	Melodic Tom
118	Syn Drum
119	Reverse Cymbal
120	Guitar Fret Noise
121	Breath Noise
122	Seashore
123	Bird
124	Telephone
125	Helicopter
126	Applause
127	Gunshot
128	Hi-Q
129	Slap
130	Scratch Push
131	Scratch Pull
132	Sticks
133	Square Click
134	Metronome Click
135	Metronome Bell
136	Low Kick
137	Kick
138	Rimclik
139	Acoustic Snare
140	Handclap
141	Electric Snare
142	Tom Low
143	Closed Hi-Hat
144	Tom Hi
145	Pedal Hi-Hat
146	Tom Hi
147	Open Hi-Hat
185	Bell Tree

ID	Description
148	Low Mid Tom
149	High Mid Tom
150	Crash Cymbal 1
151	High Tom
152	Ride Cymbal 1
153	Chinese Cymbal
154	Ride Bell
155	Tambourine
156	Splash Cymbal
157	Cowbell
158	Crash Cymbal 2
159	Vibraslap
160	Ride Cymbal 2
161	High Bongo
162	Low Bongo
163	Mute High Conga
164	Open High Conga
165	Low Conga
166	High Timbale
167	Low Timbale
168	High Agogo
169	Low Agogo
170	Cabasa
171	Maracas
172	Short Whistle
173	Long Whistle
174	Short Guiro
175	Long Guiro
176	Claves
177	High Wood Block
178	Low Wood Block
179	Mute Cuica
180	Open Cuica
181	Close Triangle
182	Open Triangle
183	Shaker
184	Jingle Bell
185	Bell Tree

ID	Description
186	Castanets
187	Mute Surdo
188	Open Surdo
189	Brush Snare High
190	Brush Snare Low
191	Soft Piano
192	Reflection Piano
193	Flange Piano
194	Octopus Piano
195	Flange Electric Piano
196	Tremolo Electric Piano
197	Chorus Harpsichord
198	Ondioline
199	Curious Chime
200	Swirly Bell
201	Echo Bell
202	Vibraphone 2
203	Soft Marimba
204	Percolator
205	Reverse Bell
206	Percussive Piano
207	Rot. Speaker Organ 1
208	Bright Perc Organ
209	Growl Organ
210	Chorus Church Organ
211	Sawteeth
212	Expressive Accordion
213	Corny Harmonica
214	Squeeze Box
215	Acoustic Bass Gtr
216	Mute Guitar 2
217	Chorus Jazz Guitar
218	Tremolo Guitar
219	Echo Mute Bass
220	Grungey Guitar
221	Flange Guitar
222	Flange Guitar Stab
223	Dark Syn Bass

ID	Description
224	Jungle Bass
225	Jungle Bass 2
226	Chorus Bass
227	Synth Slap Bass
228	Lowrider
229	OB Bass
230	OB Bass 2
231	Synth Violin
232	Robot Threat
233	Formula 1
234	Deep Bass Stab
235	Trill Strings
236	Cello Stroke
237	VibHarp
238	Tuned Drum
239	sfz Strings
240	Moving Strings
241	Heads of Space
242	Slow Synth Strings
243	Slow Choir Aahs
244	Pulsing Voices
245	Cloudscapes
246	Hype Orch Hit
247	Accent Trumpet
248	Accent Trombone
249	Mellow Trombone
250	Muted Trumpet 2
251	French Horn Swell
252	Brass Ensemble 2
253	Syn Brass 3
254	Syn Brass 4
255	Lyrical Sax
256	Accent Sax
257	Slow Sax
258	Staccato Sax
259	Lyrical Oboe
260	Soft Lead Synth
261	Staccato Bassoon

ID	Description
262	Smooth Clarinet
263	Accent Piccolo
264	Lyrical Flute
265	Mello Breath
266	Peruvian
267	Breath Echoes
268	Apparition
269	Humorous Whistle
270	Strobes
271	Teletronic
272	5th Pulse
273	Moon Jelly
274	Ricochet Pad
275	Rock Radiation
276	Solo Vox 2
277	5th Saw Drone
278	Lead Synth 2
279	Fantasy Bells
280	Slow Warm Pad
281	Polysynth 2
282	50's Sci-Fi
283	Watery Glass
284	UFOs
285	Soprano
286	Refractions
287	Comet Tails
288	Soundtrack 2
289	Friendly Data
290	Analog Sequence
291	Luminous Voice
292	Goblins 2
293	Tick Blok
294	Droplet
295	Droplet 2
296	Video Game 1
297	Video Game 2
298	Digi-Dodo
299	Fairy Godmother

ID	Description
300	Alarm
301	Hoverbug
302	Crickets
303	Beatnik
304	Teletype
305	Carriage Return
306	Typewriter Key
307	Cash Register
308	Thru Phone Chirp
309	Whipped
310	Pop Click
311	Metal Chirp
312	Poing
313	Metal Spray
314	FlyBy 1
315	FlyBy 2
316	Cosmic Ray
317	SampHold
318	SampHold 2
319	tablaesque_lo
320	tablaesque_hi
321	nine_inch_kick
322	hippishake
323	ScienceTom
324	click
325	rvs cymb pan long
326	rvs cymb pan med
327	rvs cymb pan shrt
328	woodstick
329	electrobrite
330	SloLaser
331	ufo-by
332	air snare
333	weird snare
334	flange snare
335	ping drum
336	itchy-scratch
337	itchy-scratch2

ID	Description
338	hi_metallic_snare
339	noise echo
340	buzzy hit
341	rez_hat
342	bucket hit
343	icecube
344	explosive kick
345	mutant cowbell
346	Temple Bell
347	Hi Temple Gong
348	Thuddy Kick
349	LoBell
350	sinechirp
351	hollow_metal_hit
352	woodblock
353	reverse cymbal
354	tablaesque_slap
355	sonarblip
356	sinehit
357	sineblock
358	Krelltone
359	sine_kick
360	hi-tone*
361	hi-click
362	Gate-tone
363	chem-tone
364	dub_kick
365	Untitled

Appendix E – Graphic Examples of Object Shape

