Spectrum Manager Version 1.2 Overview

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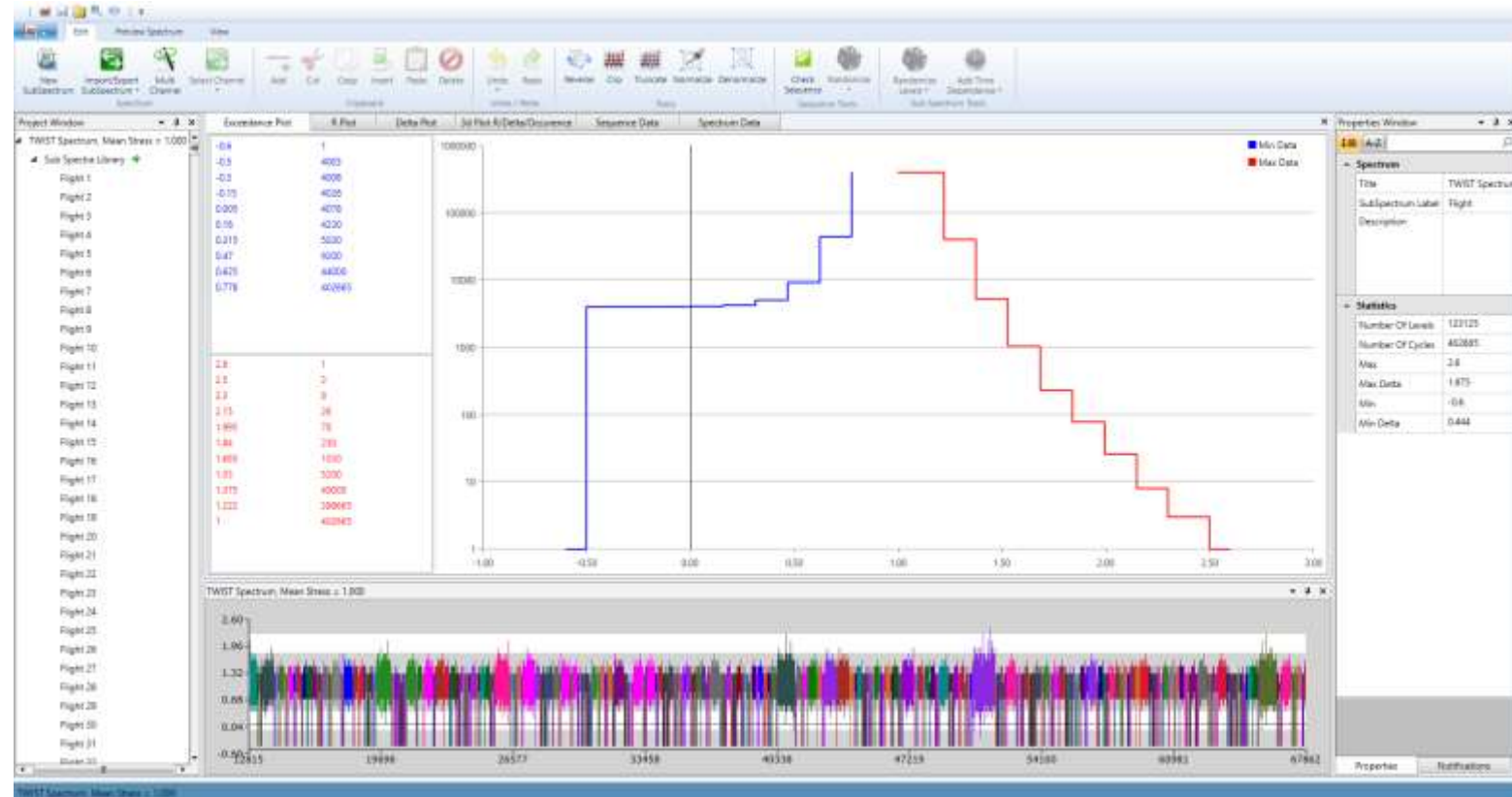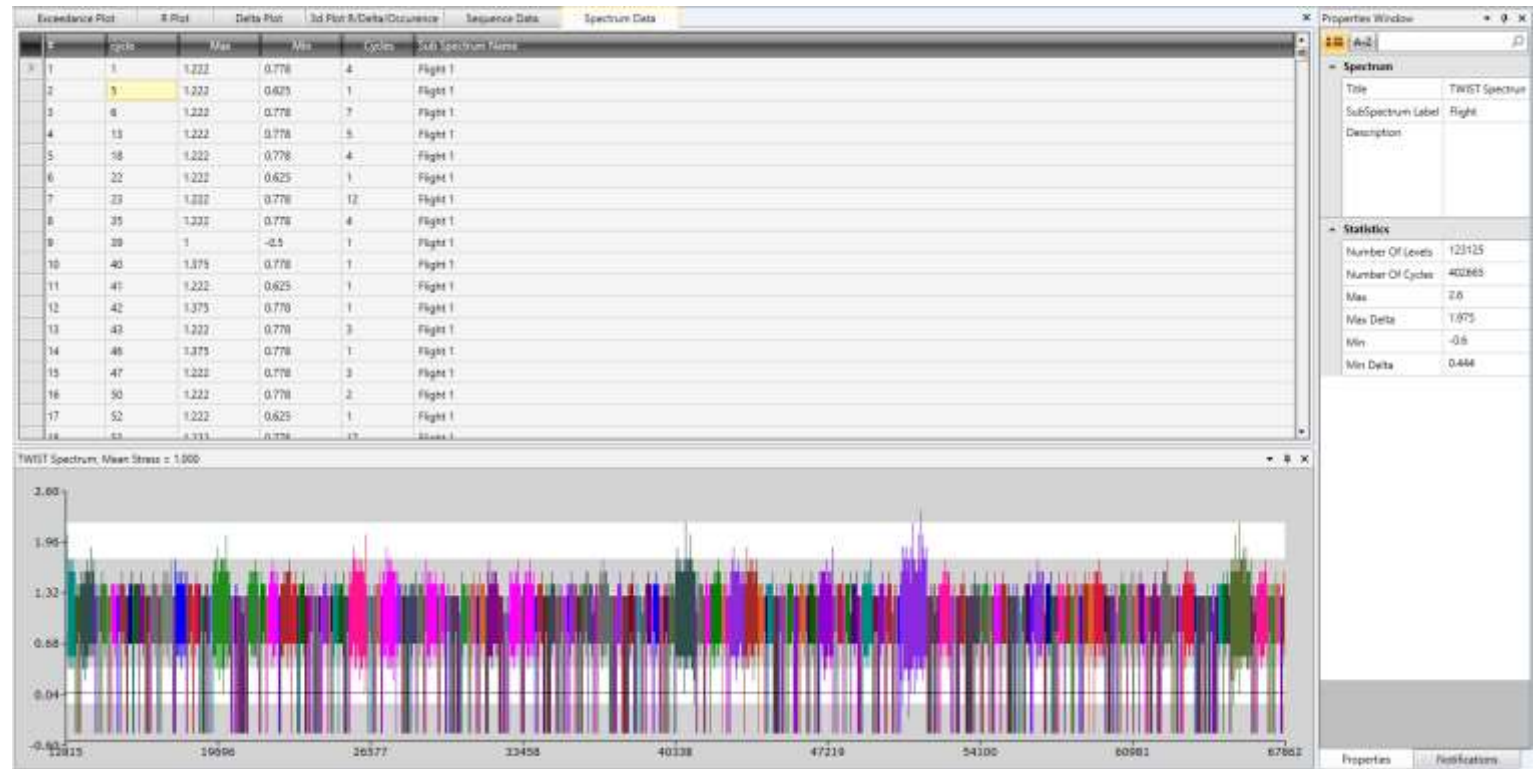# What is Spectrum Manager

- Next evolution in AFGROW Spectrum generation using XML capabilities.

- Used to Generate Spectrum files for use in AFGROW.

- Create, Edit, and View Spectra Data through multiple detailed windows.

- Customizable window layout.

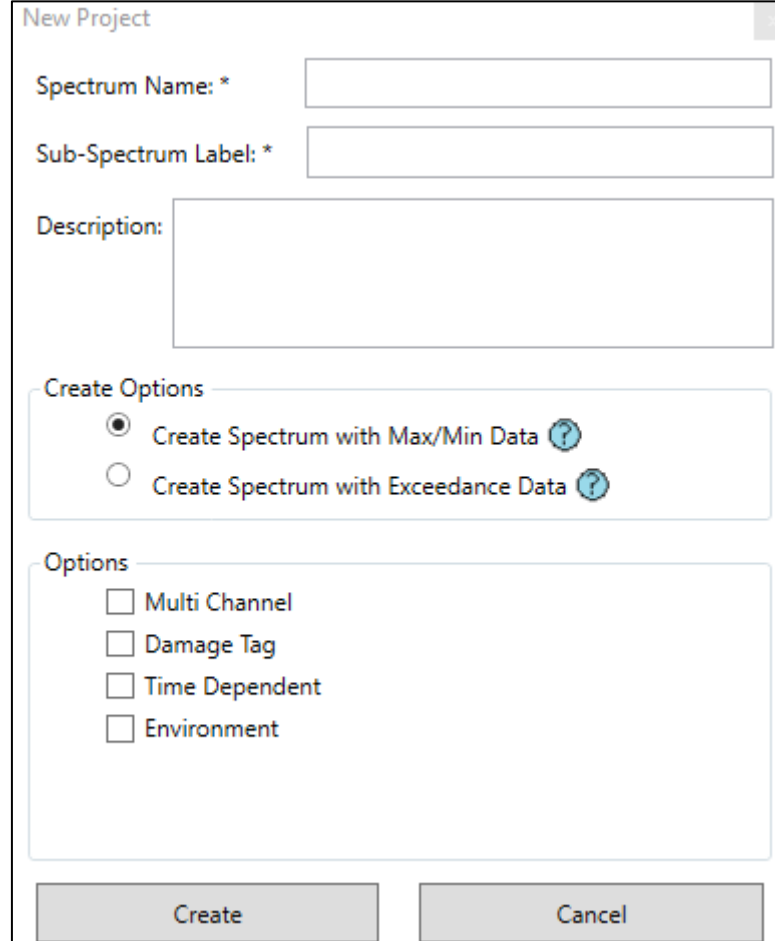- Resulting Spectrum files are cycle-counted

Basic Capabilities

- Visual spectrum design
- Sub-spectra organized in any user-defined sequence
- Spectrum statistics at a glance
- Exceedance curve plotting
- R-plots
- Sub-spectra tagging for future analysis
- Synchronized data views
- Spectrum level damage tagging
- Spectra normalization/de-normalization
- Clipping/Truncation capability

Creating a new Spectrum Project with Spectrum Manager

Spectrum Generation from Max/Min Data

- Select the "Create Spectrum with Max/Min Data" option in the New project dialogue

- Start with an empty project

- Create new sub spectra with cycle counted Max/Min/Cycles data

- Use the GUI to edit level data

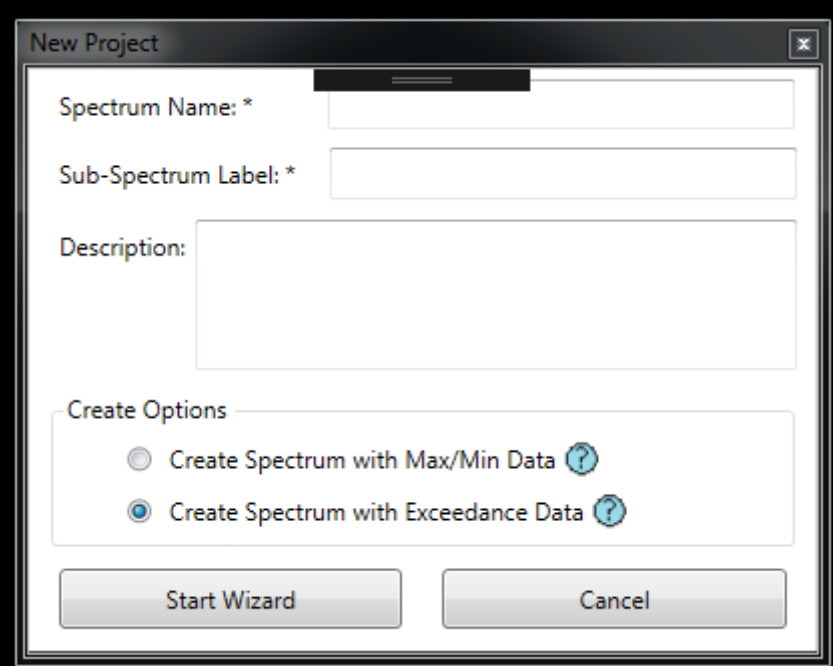- Create a sequence from sub spectra library

Spectrum Generation from Exceedance Curve

- Create a spectrum from exceedance curve data.

- Select the "Create Spectrum with Exceedance Data" option in the New project dialogue.
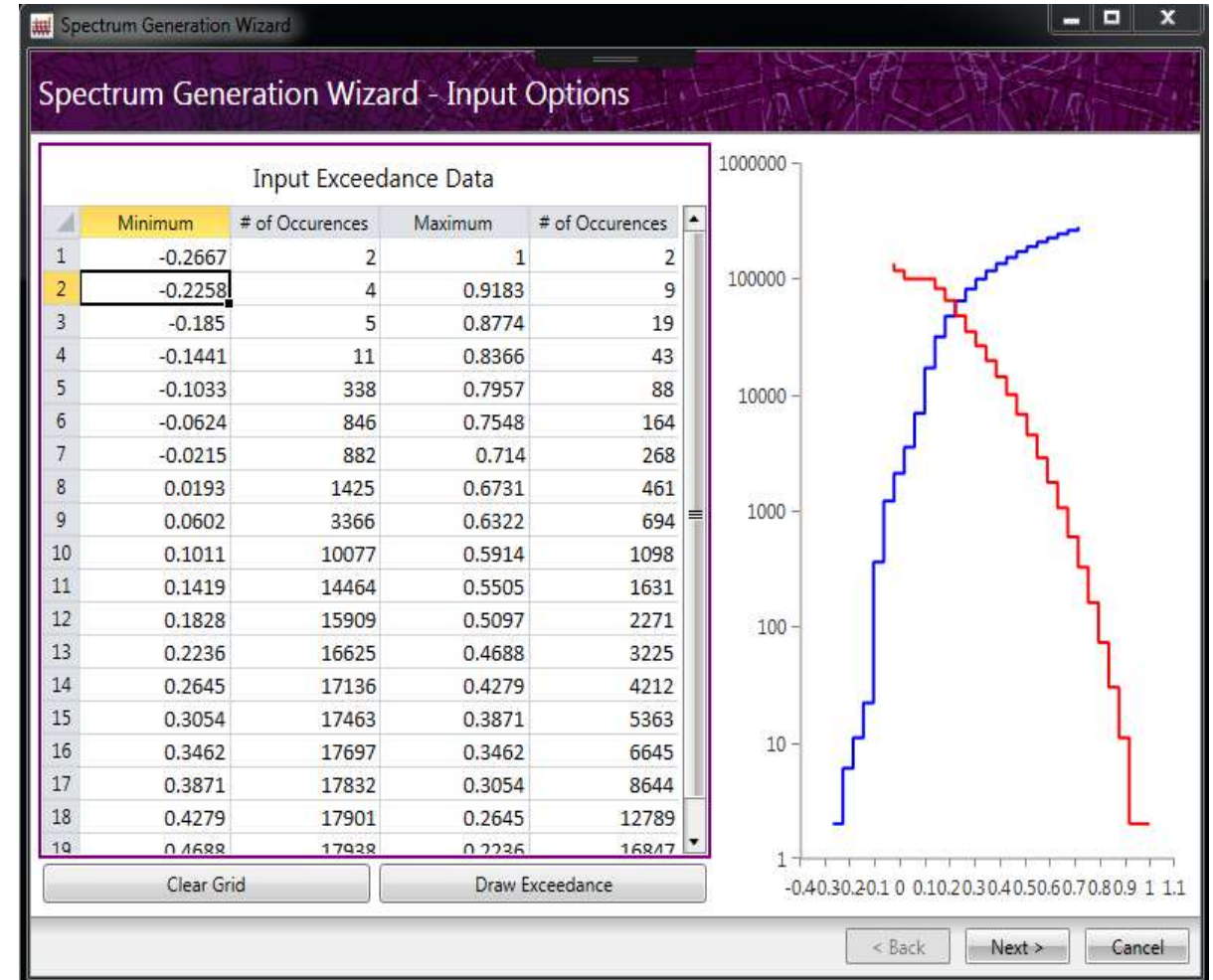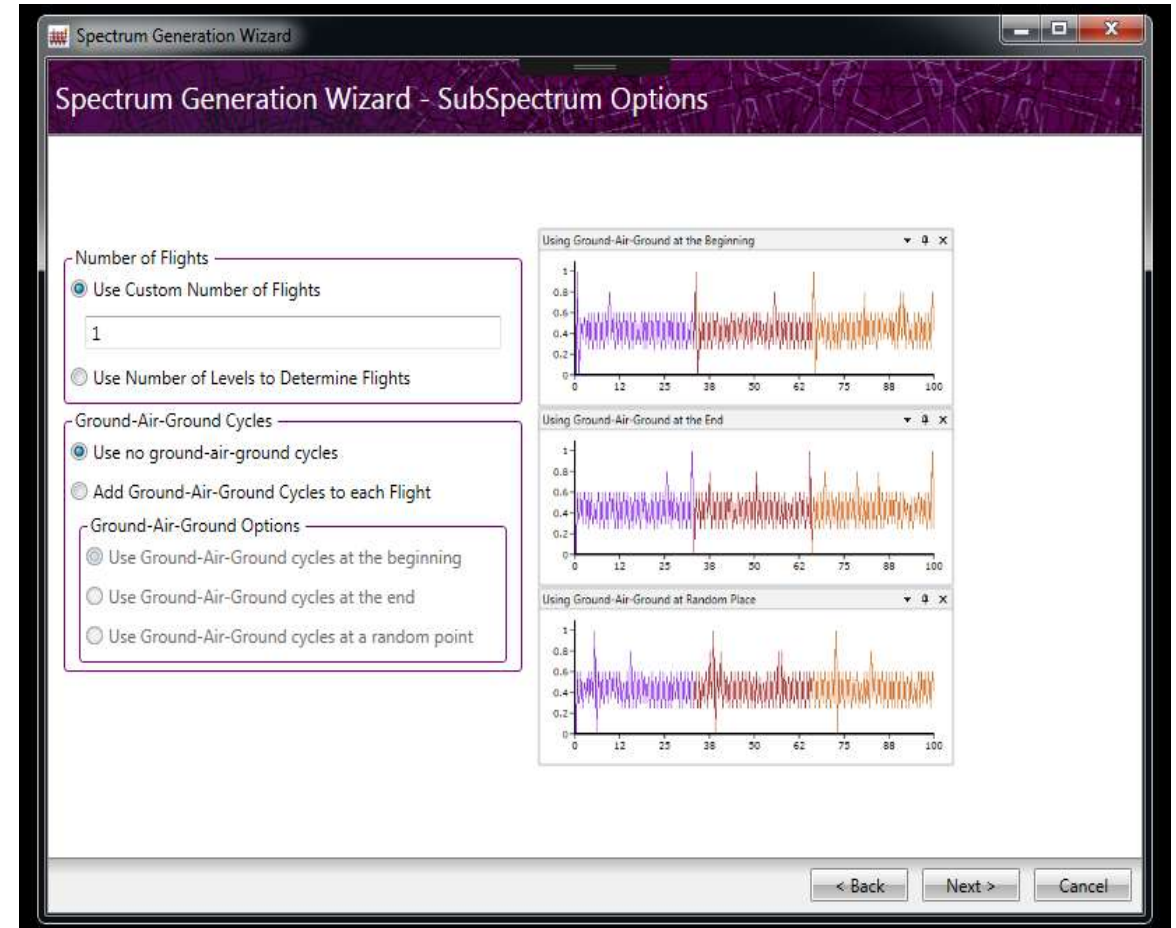
Spectrum Generation from Exceedance Curve

- Enter/Paste exceedance data into the grid (table).

- Clicking "Draw Exceedance" will create a chart visualizing the data.

Spectrum Generation from Exceedance Curve

- Specify the number of flights (sub spectra) for the spectrum, or the number of levels per flight (sub spectra).

- Ground-Air-Ground cycles can be included and placed at the beginning, end, or a random point inside each sub spectrum.

Spectrum Generation from Exceedance Curve

- Random pairing will match the Max and Min values randomly.

- Incremental pairing sorts the max and min values, then sequentially pairs the greatest max value with the least min value.

Spectrum Manager GUI

Exceedance Plot

- The exceedance plot graphs the cumulative number of stress (or load) values in the spectrum.

- The legend on the left of the exceedance plot list the max values (in red) and the min values (in blue), along with the corresponding cumulative cycles.

R-Plot

- The R Plot displays the ranges of min over max stress ratios versus the number of cycles for the entire spectrum. Users can plot R values from -100 to 1.

- The legend for the R plot is show to the left of the graph. The legend lists the ranges of stresses (or loads) ratios in the spectrum with their total number of cycles.

Delta Plot
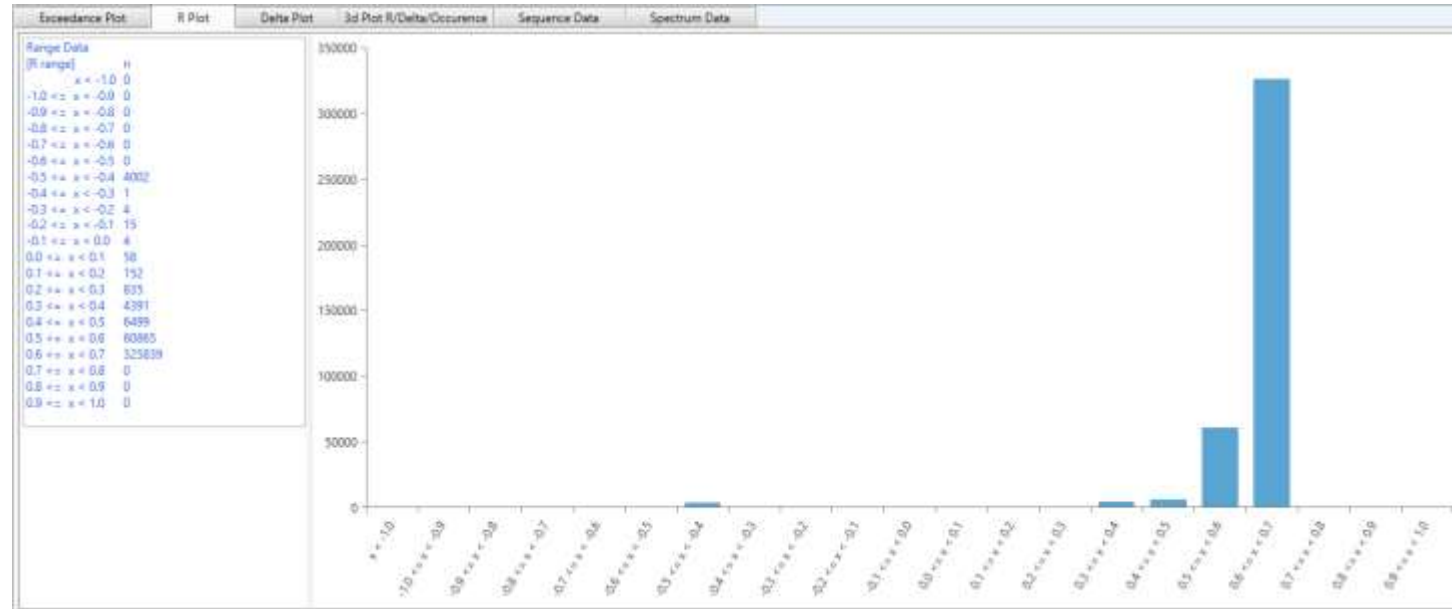
- Visual representation of the spectrum stress range values

- Legend displays the occurrences of each level's delta value.   (Max – Min)
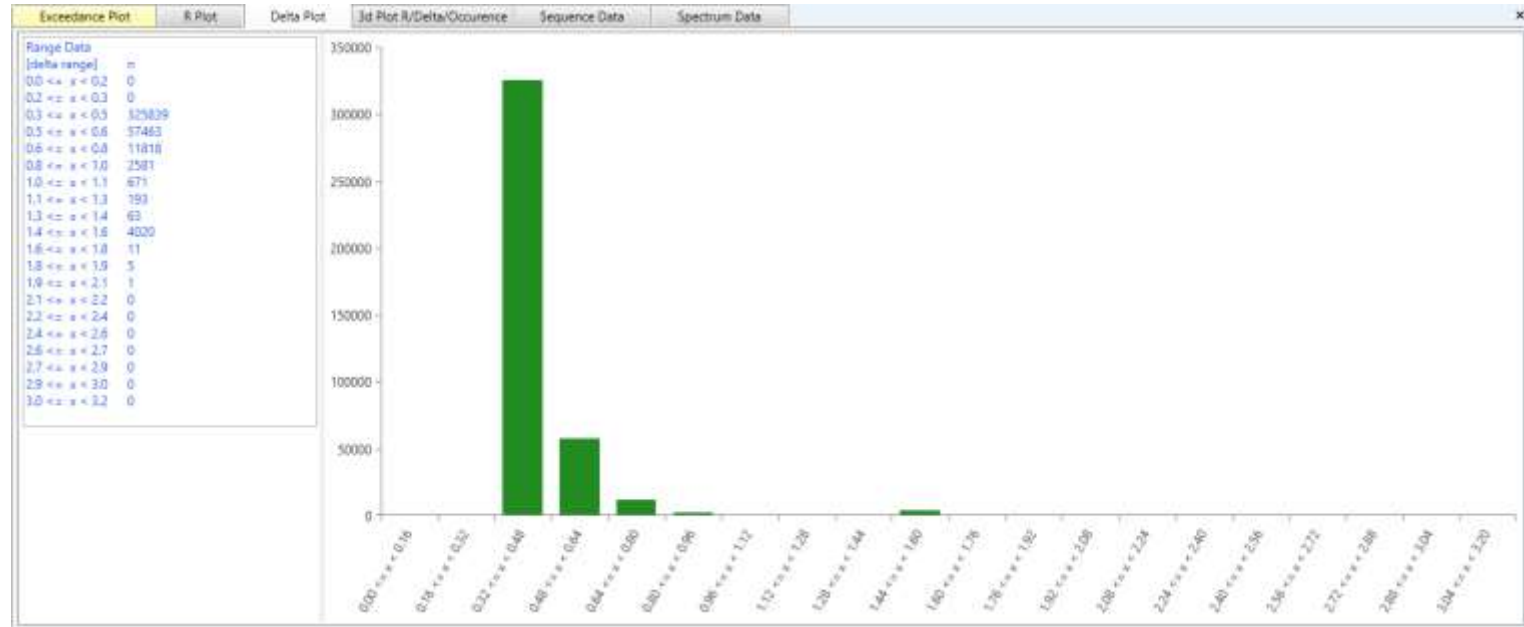
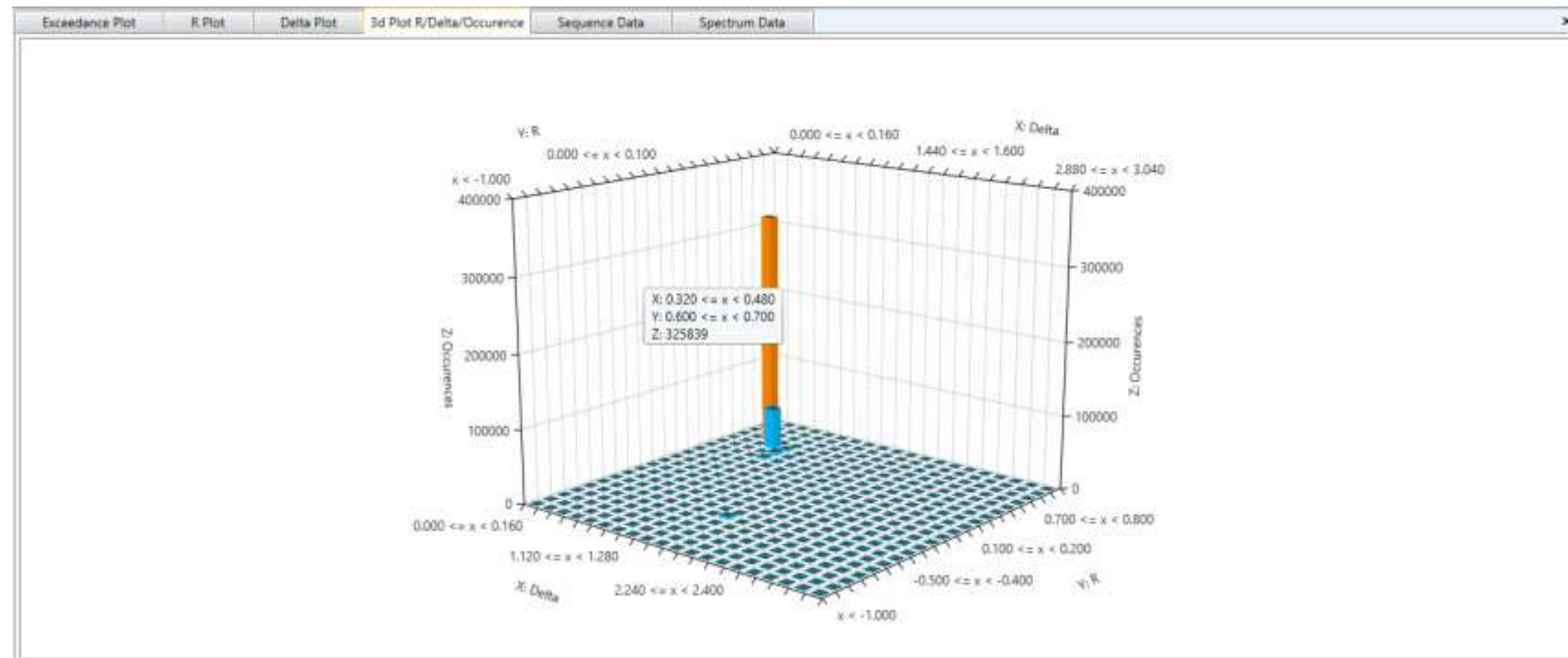# R/Delta/Occurrence 3D Plot

- Plots Delta vs R values vs Occurrences

- Hover over desired bar to see values

- Plot can be zoomed and rotated for alternate views of data

Sequence Data

- The sequence data window is where the user can place each sub spectrum from the library in the desired order.

- Cut, Copy, Insert, Paste, and Delete options are all available here.

	Position	SubSpectrumName
>	1	Flight 1
	2	Flight 2
	3	Flight 3
	4	Flight 4
	5	Flight 5
	6	Flight 6
	7	Flight 7
	8	Flight 8
	9	Flight 9
	10	Flight 10
	11	Flight 11
	12	Flight 12
	13	Flight 13
	14	Flight 14
	15	Flight 15
	16	Flight 16
	17	Flight 17
	18	Flight 18
	19	Flight 19
	20	Flight 20
	21	Flight 21
	22	Flight 22

Tabs: Exceedance Plot | R Plot | Delta Plot | 3d Plot R/Delta/Occurence | Sequence Data | Spectrum Data

Spectrum Data

- If the spectrum is selected, this window lists the values of each level of the spectrum.

- If a sub spectrum is selected in the Project Window, the window allows edits to the values of each level in the sub spectrum.

- Cut, Copy, Insert, Paste, and Delete options are all available if a sub spectrum is selected.

| Exceedance Plot | R Plot | Delta Plot | 3d Plot R/Delta/Occurence | Sequence Data | Spectrum Data |

| #	cycle	Max	Min	Cycles	Sub Spectrum Name
1	1	1.222	0.778	4	Flight 1
2	5	1.222	0.625	1	Flight 1
3	6	1.222	0.778	7	Flight 1
4	13	1.222	0.778	5	Flight 1
5	18	1.222	0.778	4	Flight 1
6	22	1.222	0.625	1	Flight 1
7	23	1.222	0.778	12	Flight 1
8	35	1.222	0.778	4	Flight 1
9	39	1	-0.5	1	Flight 1
10	40	1.375	0.778	1	Flight 1
11	41	1.222	0.625	1	Flight 1
12	42	1.375	0.778	1	Flight 1
13	43	1.222	0.778	3	Flight 1
14	46	1.375	0.778	1	Flight 1
15	47	1.222	0.778	3	Flight 1
16	50	1.222	0.778	2	Flight 1
17	52	1.222	0.625	1	Flight 1
18	53	1.222	0.778	17	Flight 1
19	70	1.222	0.625	1	Flight 1
20	71	1.222	0.778	3	Flight 1
21	74	1.375	0.778	1	Flight 1
22	75	1.375	0.778	1	Flight 1

Spectrum Plot

- Visual representation of the spectrum

- Shows the spectrum's/sub spectrum's stress vs cycles plot

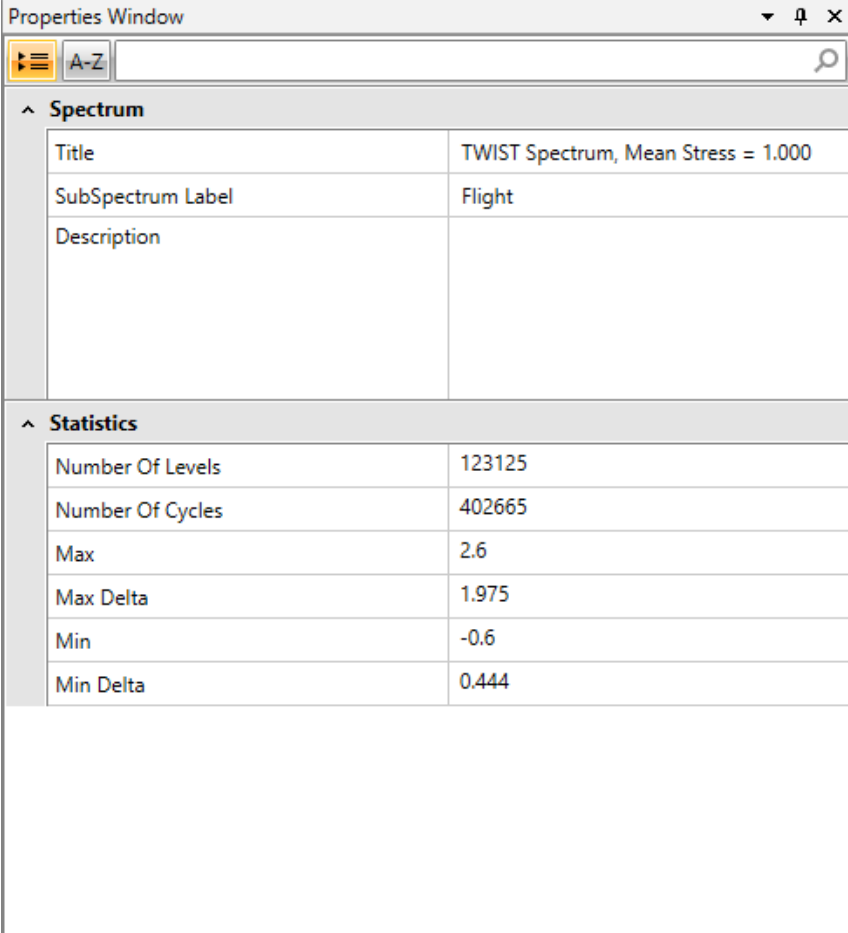- Cycles are plotted as vertical lines indicating Max/Min
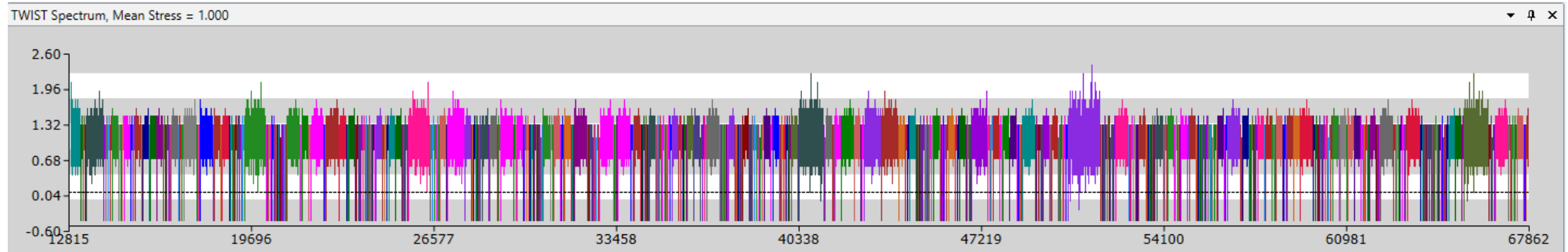
Preview Spectrum

- Zoom control
- Allows user to focus spectrum plot on selected section of spectrum/sub spectrum
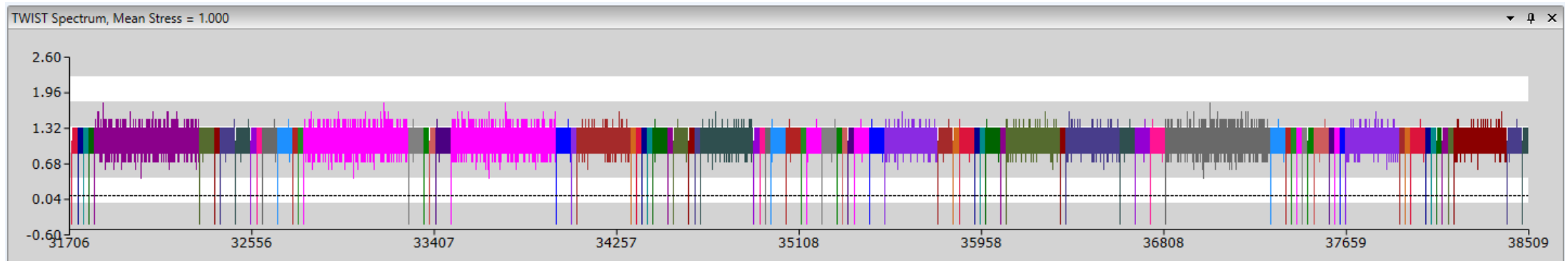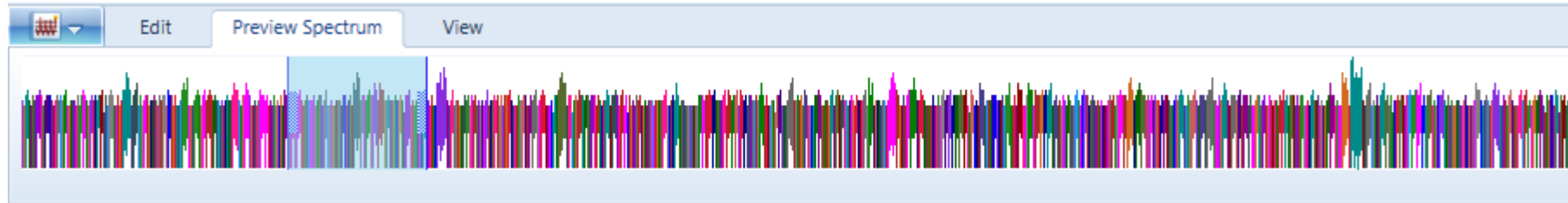
Properties

- If the spectrum is selected, the Properties Window lists the properties and statistics of the spectrum.

- If a sub spectrum is selected, the Properties Window lists the properties and statistics of the sub spectrum.

- The sub spectrum name and description are shown and can be edited in this window.
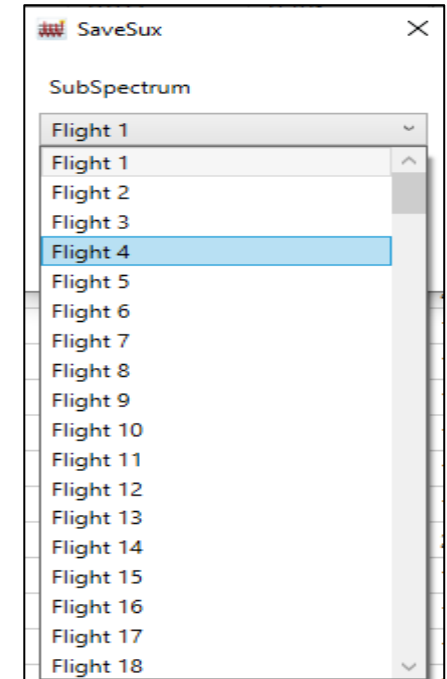
Spectrum Manager Commands

Export Sub-Spectrum

- Save a single sub spectrum as a .sux file.
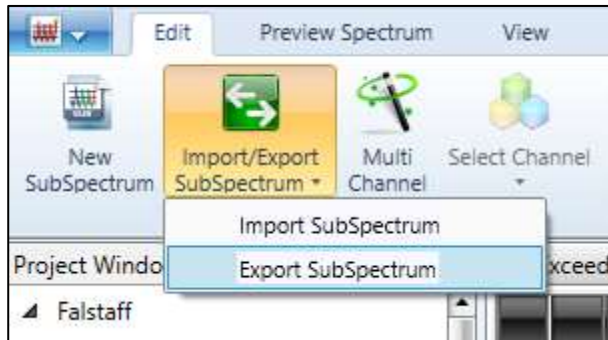
- Click on the Import/Export Sub spectrum button and select Export.

  - Select which sub spectrum to save from the dropdown and click OK. Navigate to a path to save the file to, and click Save.

Import Sub-Spectrum

- Can import either .sub or .sux files

- When importing a .sux file, an option will be presented to either use the sub spectrum name included with the .sux file properties, or to autogenerate a name for the sub spectrum based off the current project's sub spectrum label.

- An imported sub spectrum will not be automatically added to the sequence and must be added through the sequence data window

Reverse

- Multiplies the maximum and minimum stress values by negative one, which will reverse the sign of the max and min values in each level of the spectrum (upper vs lower wing skin).
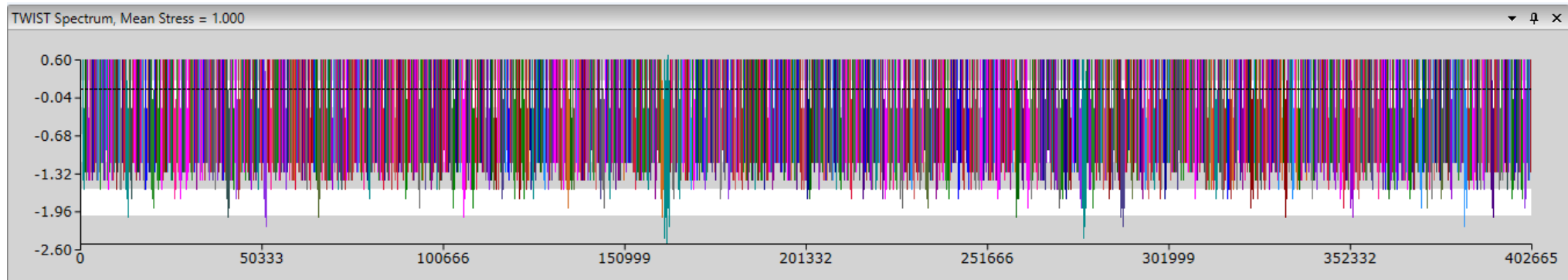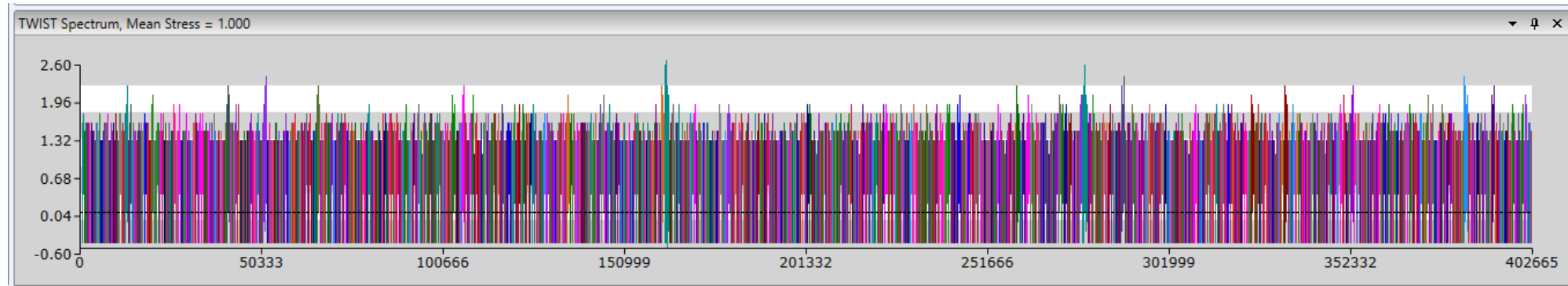
Clip

- The clip option limits the maximum stress or load value for the entire spectrum or a selected sub spectrum.
- If the max and min values of any level exceed the upper bound, that level will be removed.

Truncate

- Allows the user to set limits to the difference, or "delta", between the maximum and minimum stress (or load) values for all the levels in the spectrum or a sub spectrum.

- Ensures that any level that has a max and min with a difference less than the delta value will be deleted.

- If a sub spectrum would have all levels deleted, the user is prompted to delete the sub spectrum.

Compressive Truncation
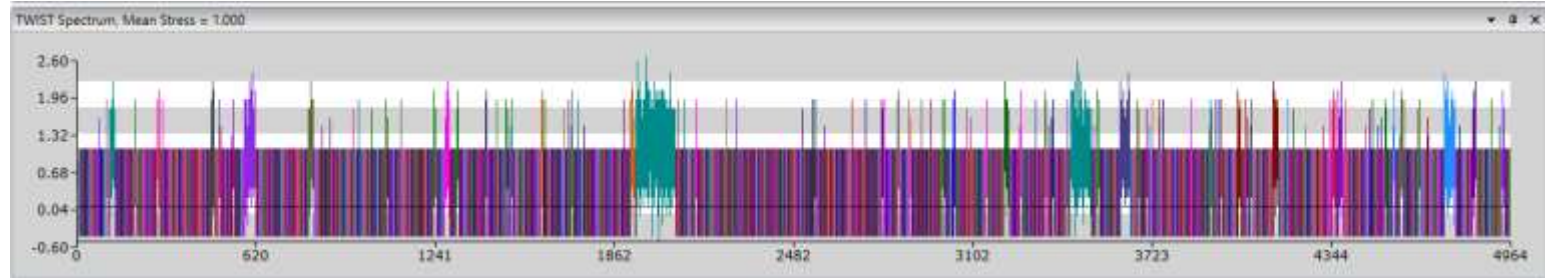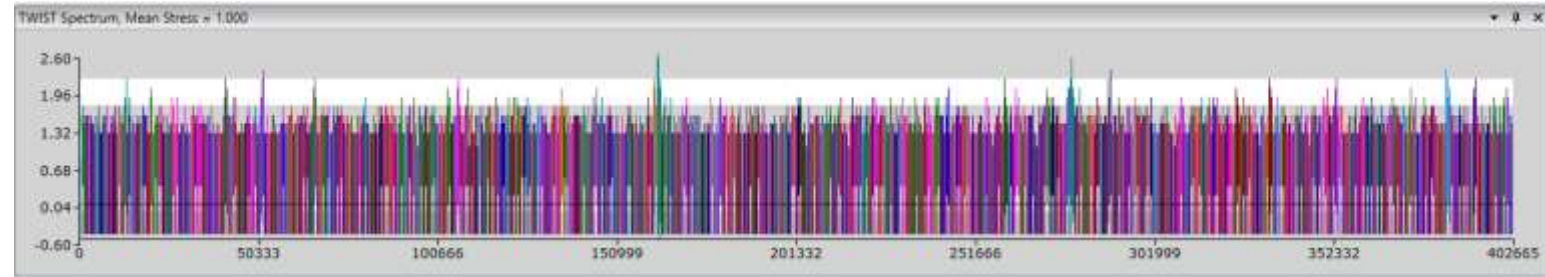
- Truncate by Compressive Average Only.

- Checking the Compressive Average box tells the truncation operation to only remove levels meeting the truncation criteria whose average value is negative.

- A prompt will appear to remove any resulting empty sub spectra.
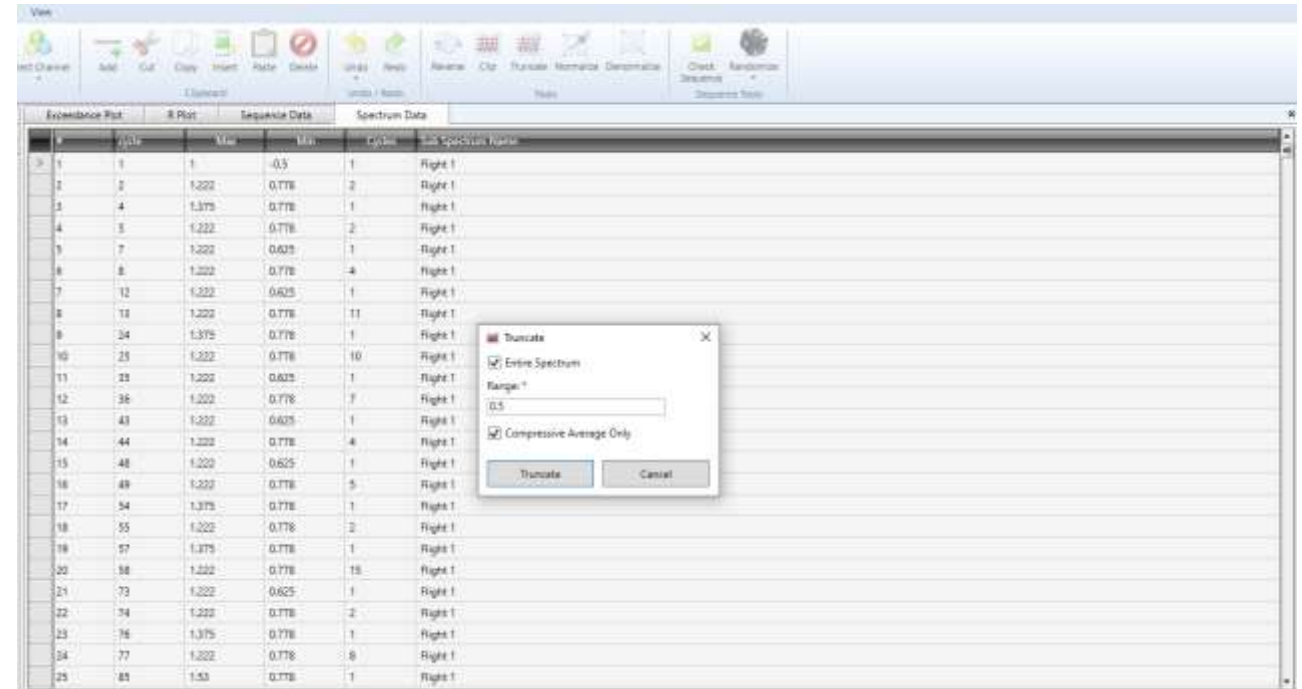
Normalize/Denormalize

- Divides each max and min value by the factor entered in the normalization dialog.

- By default, the normalization factor is the maximum value in the spectrum setting the max value in the spectrum to 1.

An example of a spectrum normalized by 2.6

Randomize Sub Spectra
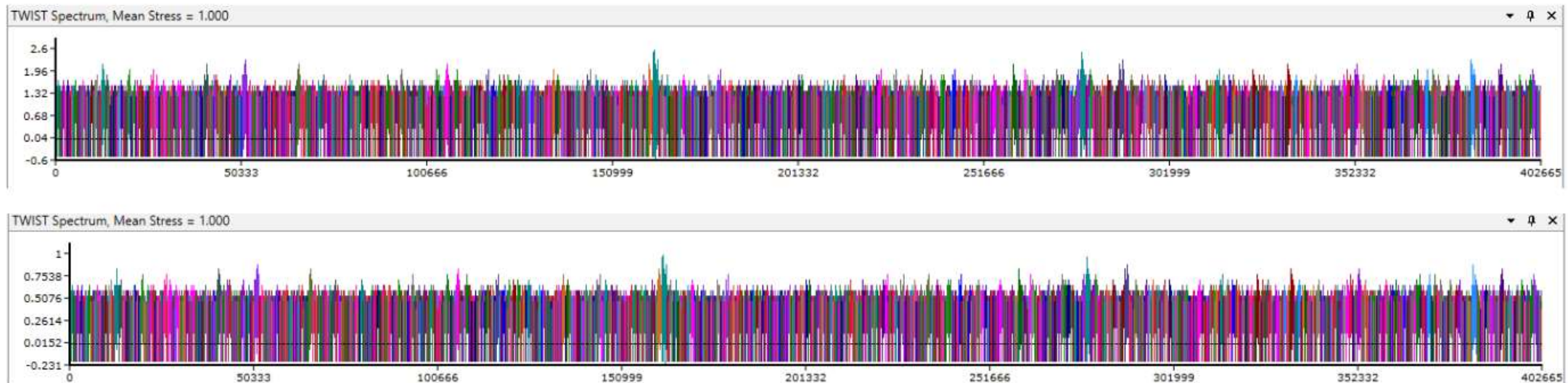
- Arranges all sub spectra in the project's Sub Spectra Library into a sequence in random order.
- Each sub spectrum will appear in the sequence a number of times equal to the Occurrences value next to the sub spectrum name.
- Uses the seed value set in project options.
- Will overwrite the existing sequence, if one exists.

Randomize Sequence
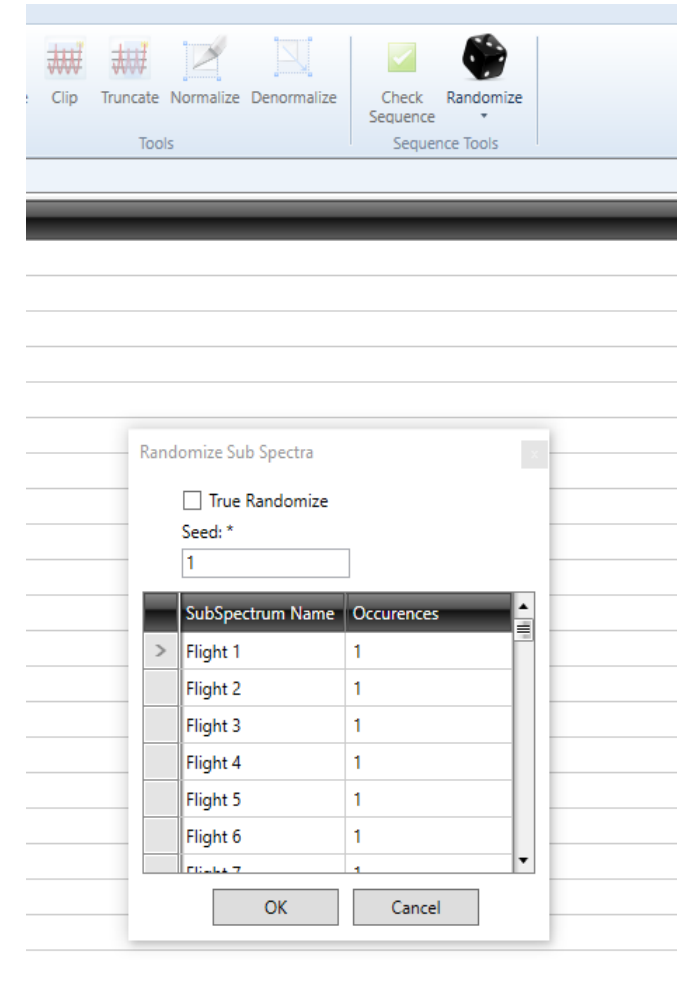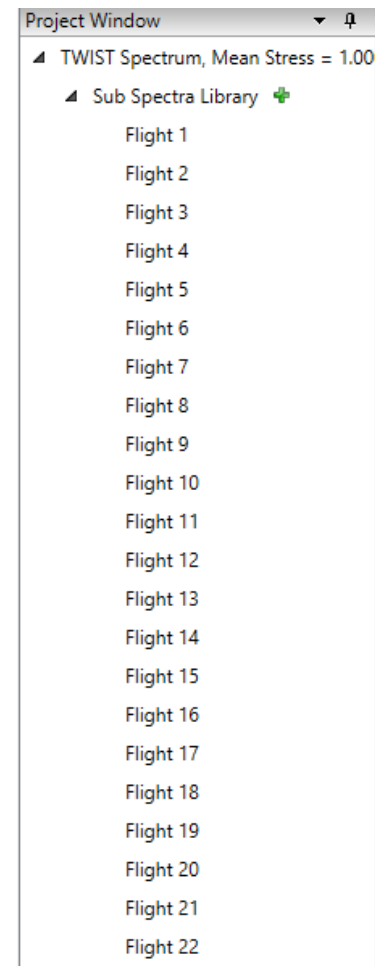
- Will arrange all sub spectra in the current sequence into a new sequence in random order.

- There must be an existing sequence.

- Each sub spectrum will be appear in the sequence a number of times equal to the Occurrences value next to the sub spectrum name.

- Uses the seed value set in project options.
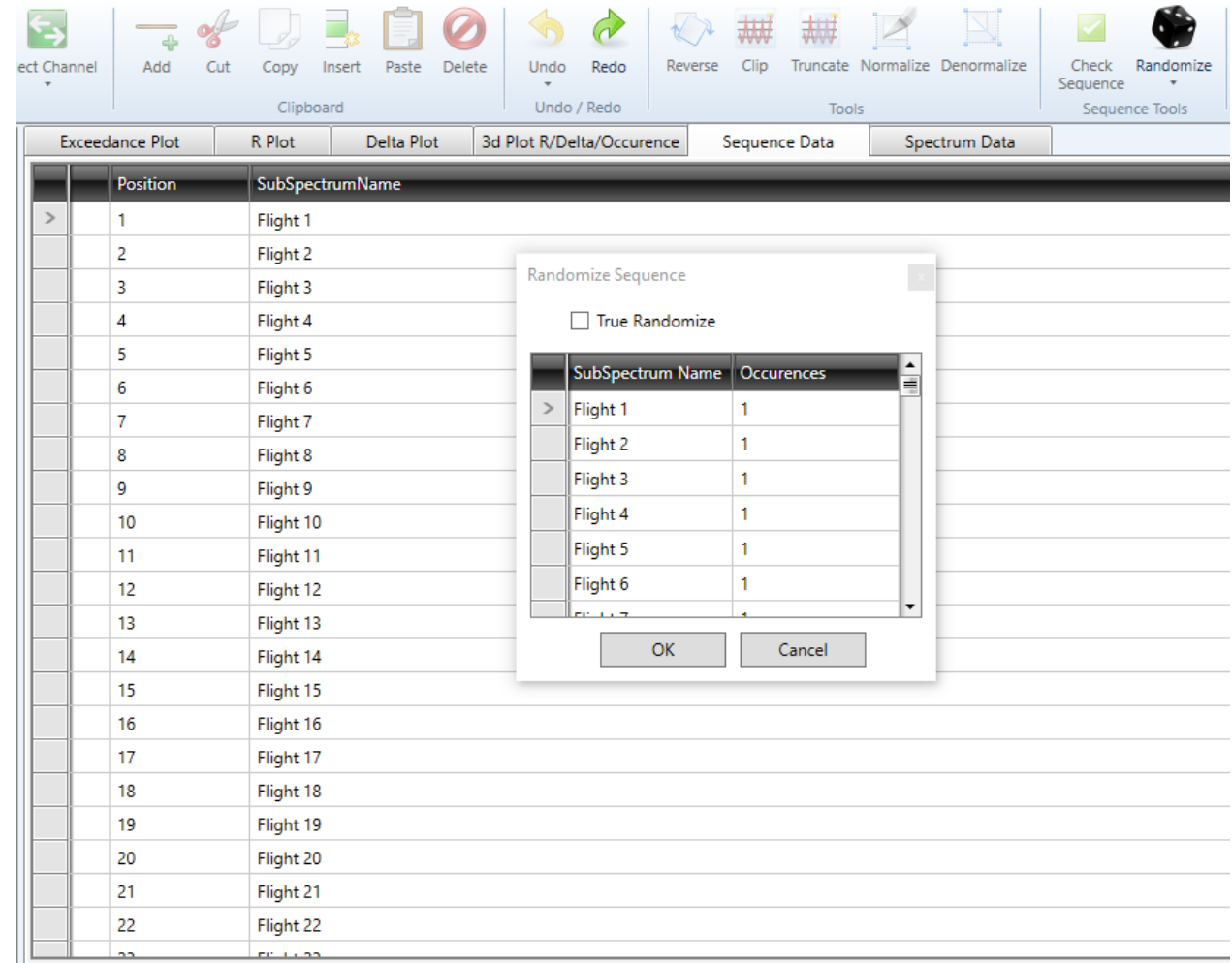
Randomize Levels

- Will shuffle the order of levels in a sub spectrum by levels or by cycles

- Randomize by cycles splits each level into a number of equivalent levels with one cycle each, shuffles them, then combines adjacent equivalent levels
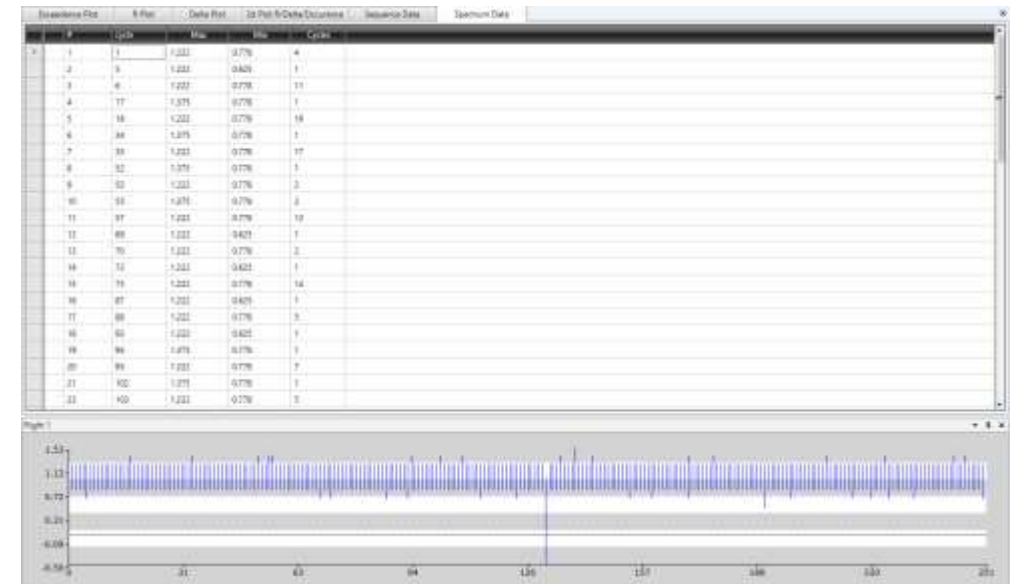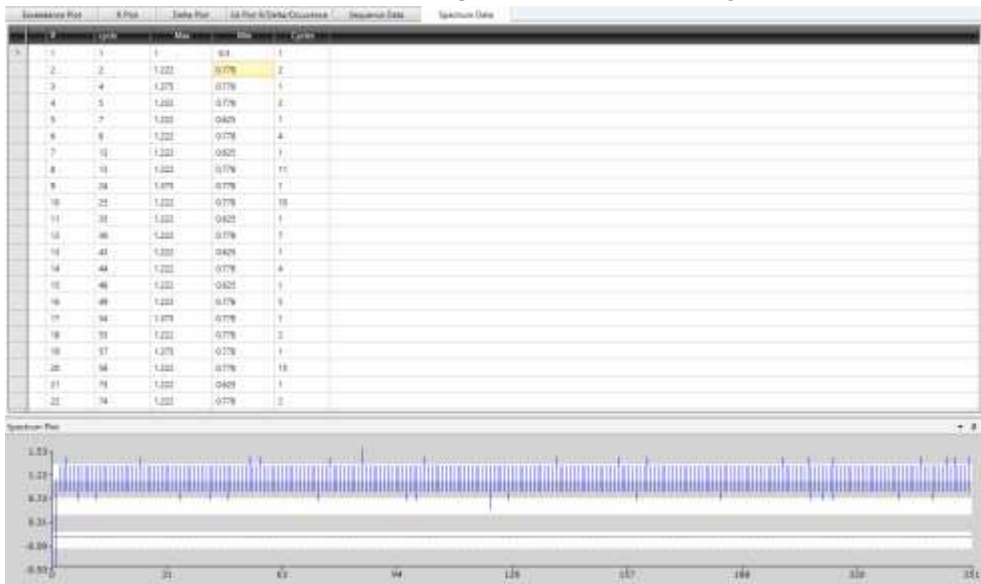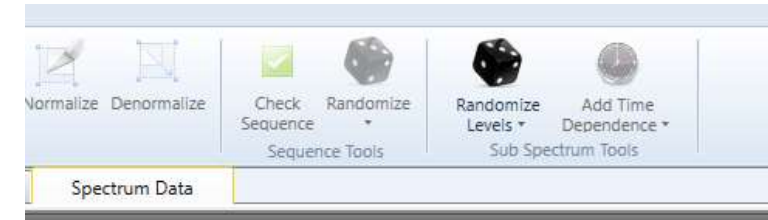
Additional Features

Preference Options

- Enable damage tags, environmental tags, and time dependent parameters.

- You can interchange the x and y axes of the Exceedance chart

- Set the text size, number of decimal places, and the seed value for randomization functions
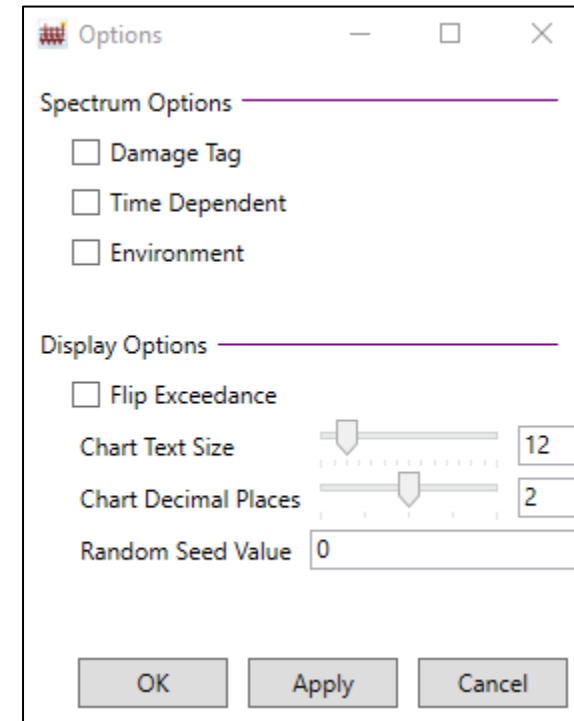
Context Sensitive Help

- Contains additional information on every current feature of Spectrum Manager.

- Also contains guides explaining how to do basic operations in Spectrum Manager.

- By clicking on a section of the GUI and pressing "F1," the relevant page in the Help guide will be opened.

COM Support
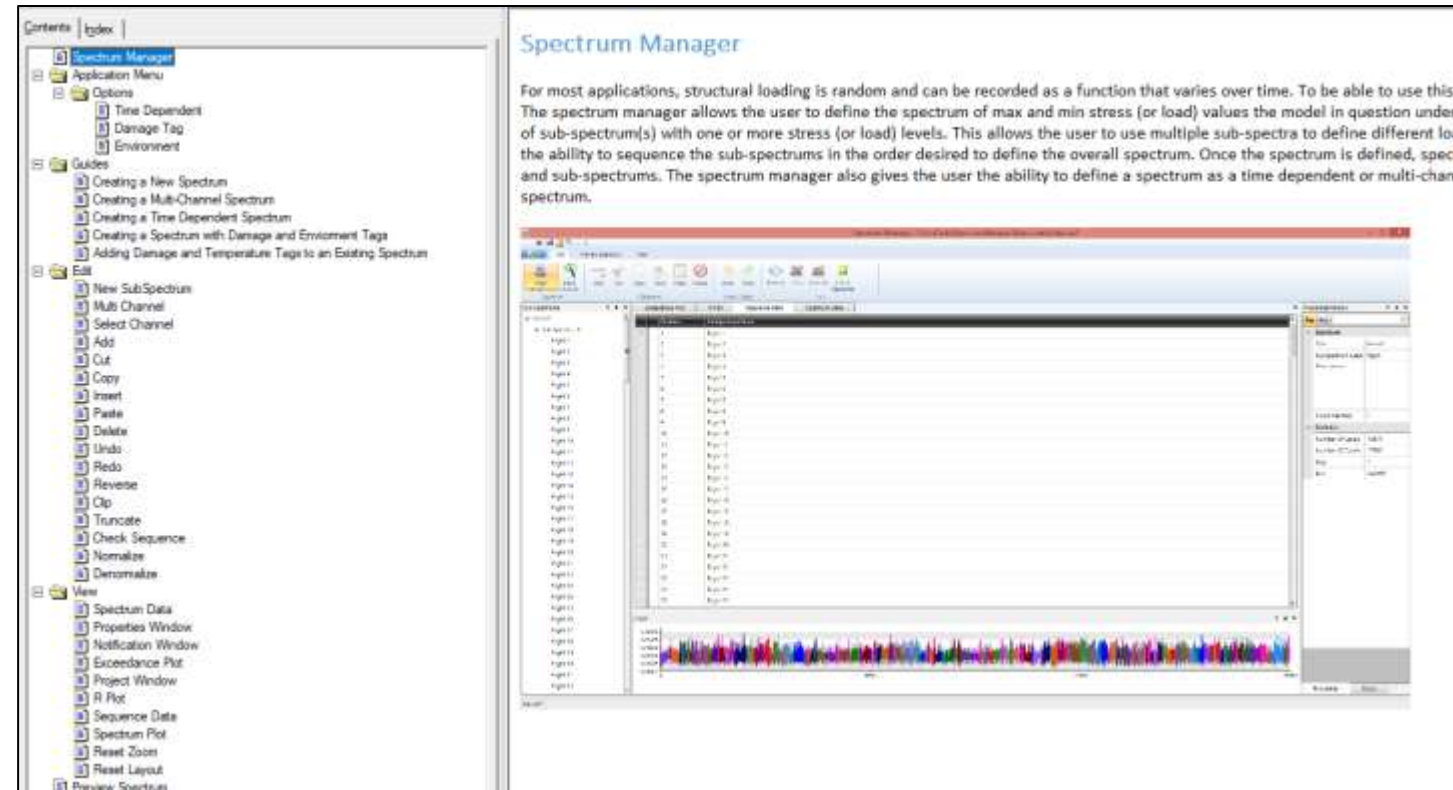
- Preform most often used Spectrum Manager actions through COM
- Create a new spectrum/Edit existing spectrum
- Get statistics of spectrum/single sub spectrum
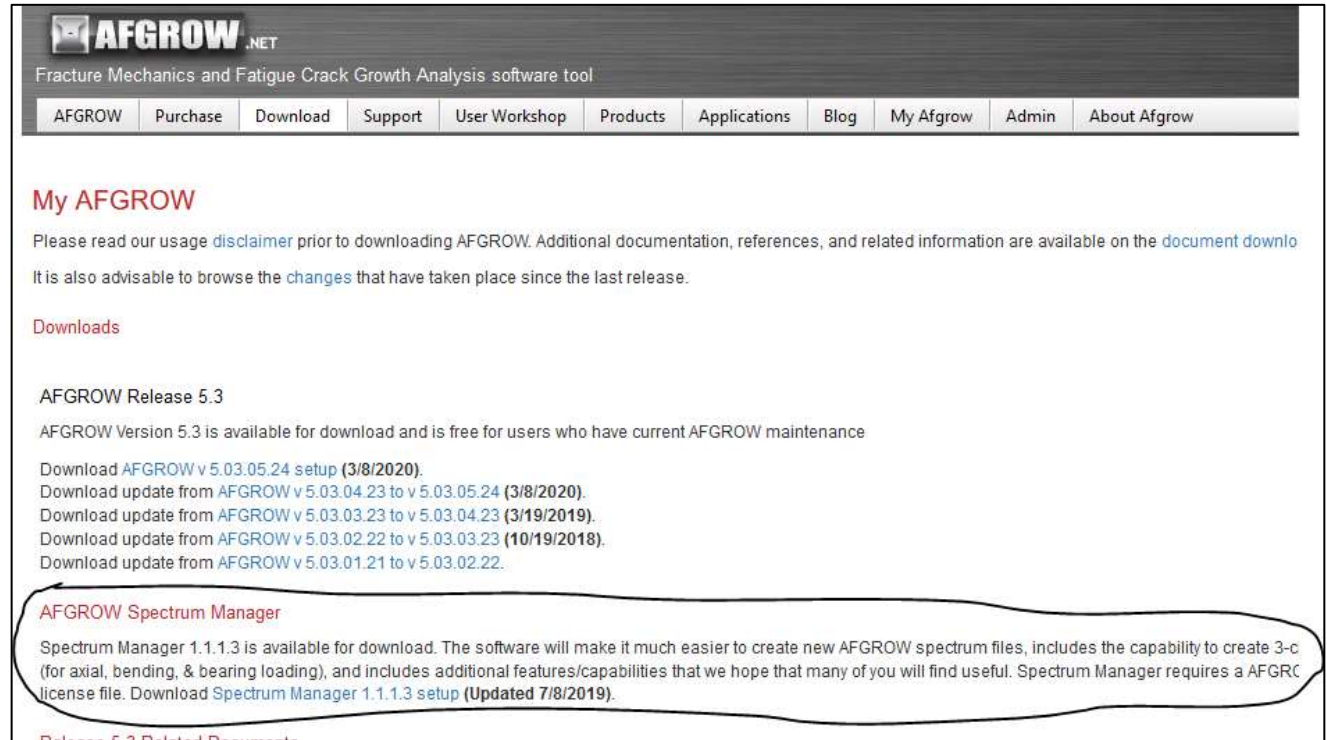- Reverse, Clip, Truncate spectrum/single sub spectrum
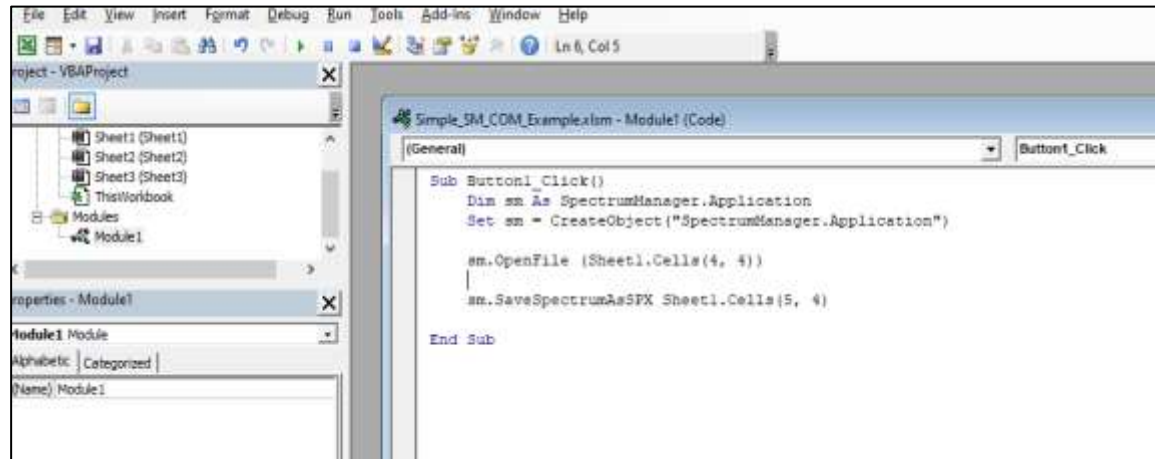
History Log

- Log of major events

- Examples include Clip, Truncate, Randomization, Reversal, and Normalization

- Includes the time, date, and description of the event

Description	Timestamp
Spectrum Reversed	6/28/2021 12:57
Spectrum Normalized	6/29/2021 10:18
Spectrum Reversed	6/29/2021 13:30
Spectrum Normalized	6/29/2021 13:31
Spectrum Sequence Randomized	6/29/2021 13:31

Download Spectrum Manager

- Download can be found on AFGROW.net

- Currently separate installation from AFGROW

- Available to anyone with a current AFGROW license

- Version 1.2 to be released with upcoming AFGROW release 5.4 and included in AFGROW installation

Conclusion

- Spectrum Manager v 1.2 brings several new features including Spectrum Generation from Exceedance Curve data, improved application speed, randomization options, a new preview selector and spectrum chart, and COM support.

- Version 1.2 will be available to licensed users with the next release of AFGROW 5.4

Questions/Comments?