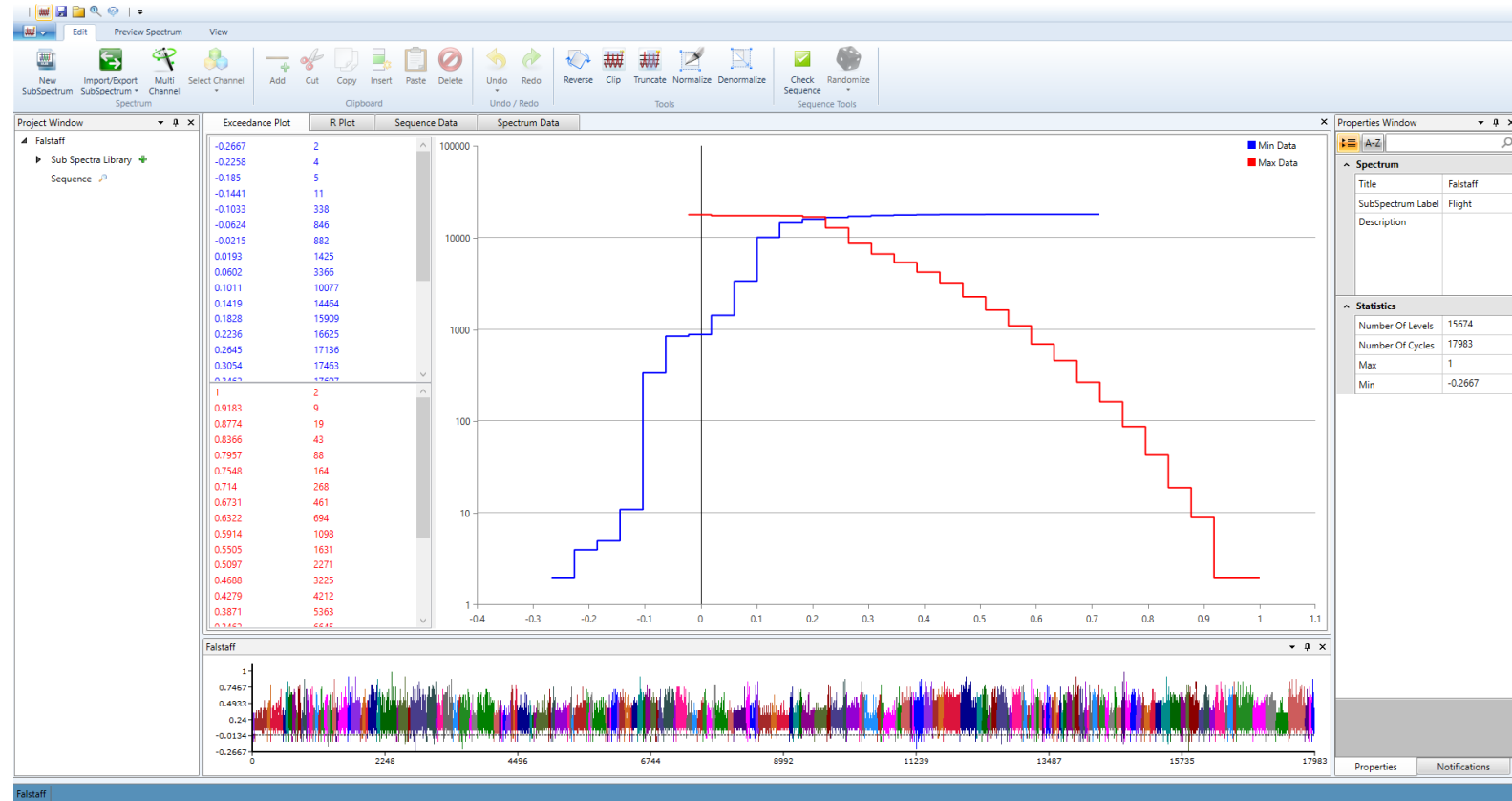


Current Spectrum Manager Release Overview (Version 1.2)

Matthew Gross, James Lambert (LexTech Inc.)

What is Spectrum Manager

AFGROW Spectrum Manager is a user-friendly Windows based software application that uses a visual approach to develop and modify structural loading spectra for damage tolerance analysis.



Primary capabilities and features

- Visual spectrum design
- Spectrum statistics available at a glance
- Sub-spectra may be organized in any user-defined sequence
- Sub-spectra may be placed in the sequence more than once
- Sub-spectra may be re-ordered in the sequence
- Import data from "old" AFGROW text-based sub-spectrum files
- Import/Export individual sub spectra
- Exceedance curve plotting
- Stress ratio plotting (R-plots)
- Delta Plot View
- 3D Plot R/Delta/Occurrences
- Synchronized data/spectrum plot views
- Spectrum level tagging for environmental effects
- Spectrum level damage tagging to track damage accumulation
- Spectra normalization/de-normalization
- Clipping/Truncation capability
- Compressive Truncation
- Spectrum Generation from Exceedance Curve Data
- Randomize Sub Spectra, Randomize Sequence
- COM support
- Context-Sensitive Help
- Undo/Redo capability

Spectrum Structure

Spectrum Structure - Level

- A spectrum level is the basic building block of a spectrum.
- A Level consists of Max stress, Min stress, and number of cycles.
- In addition, a Level can have any combination of time dependent parameters, environmental, and damage tags.

	#	cycle	Max	Min	Cycles
>	1	1	1	-0.5	1
↕	2	2	1.222	0.778	2
	3	4	1.375	0.778	1
	4	5	1.222	0.778	2

Time Dependent Option

- Allows the user to add a Time and Load Type value to a level in a sub spectrum
- Can be used in AFGROW for modeling corrosion effects and/or time dependent crack growth
- Enumerated integer values or keywords are used to indicate load type:
 1. Random Cyclic Sequence (assumed to be sinusoidal)
 2. Ramp Up (may only have one level describing the ramp up)
 3. Ramp Down (may only have one level describing the ramp down)

Sequence Data		Spectrum Data		
Max	Min	Cycles	Time	LoadType
1	-0.5	1	0	Random Cyclic

Environment Tag

- Defines the environment for each level in a sub spectrum using a decimal or integer value.

Sequence Data		Spectrum Data	
Max	Min	Cycles	Environment Tag
.8	-0.2	1000	1000

- If the environment tag matches the temperature value assigned to a given material set, the crack growth rate calculation will use the parameters for that material set.

Damage Tag

- Allows the user to assign a name consisting of alphanumeric characters to one or more levels in a sub spectrum to differentiate levels into various subsets.

Sequence Data		Spectrum Data	
Max	Min	Cycles	Damage Tag
1	-0.5	1	Tag

- This can be used inside AFGROW to identify the amount of the total crack growth that was caused by each subset.
- If this option is enabled, AFGROW will output a damage summary for each subset as well as each sub spectrum (regardless of whether any levels in a given sub spectrum have been tagged).

Spectrum Structure – Sub Spectra

Sub Spectra are made up of one or more Levels.

All Sub Spectra added to the project are visible in the Project Window


Sub Spectra Library +				
Flight 1				
Flight 2				
Flight 3				
Flight 4				
Flight 5				
Flight 6				
Flight 7				
Flight 8				
Flight 9				
Flight 10				
Flight 11				
Flight 12				

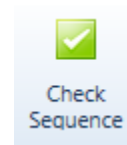
1	1	1	-0.5	1
2	2	1.222	0.778	2
3	4	1.375	0.778	1
4	5	1.222	0.778	2
5	7	1.222	0.625	1
6	8	1.222	0.778	4
7	12	1.222	0.625	1
8	13	1.222	0.778	11
9	24	1.375	0.778	1
10	25	1.222	0.778	10
11	35	1.222	0.625	1
12	36	1.222	0.778	7
13	43	1.222	0.625	1
14	44	1.222	0.778	4
15	48	1.222	0.625	1
16	49	1.222	0.778	5
17	54	1.375	0.778	1
18	55	1.222	0.778	2
19	57	1.375	0.778	1
20	58	1.222	0.778	15
21	73	1.222	0.625	1
22	74	1.222	0.778	2
23	76	1.375	0.778	1
24	77	1.222	0.778	8
25	85	1.53	0.778	1

Spectrum Structure - Sequence

- The sequence is made up of one or more sub-spectra.
- A sub spectrum can be entered into the sequence any number of times.
- The sequence is the actual spectrum.
- User will not be able to save the project if no sub spectra have been added to the sequence.
- The user can check if any sub spectra have been sequenced with the “Check Sequence” option.

Exceedance Plot		R Plot	Sequence Data	Spectrum Data
		Position	SubSpectrumName	
>	1		Flight 1	
	2		Flight 2	
	3		Flight 3	
	4		Flight 4	
	5		Flight 5	
	6		Flight 6	

 In order to save the Spectrum, after you have finished entering the SubSpectrum data, add the SubSpectrum to the Spectrum's Sequences.



Check Sequence

Following subspectra are not in use:

SubSpectrum Name
> Flight 7

Check Sequence

All subspectra are in use.

Spectrum Generation

Spectrum Generation from Sequence Data

- Add data to sub spectrum
 - Paste in from excel/text file.
 - Import from a previously exported .sub or .sux file.
 - Import from two column text file (used as Max and Min for each level, uses 1 as number of cycles value).
 - Import from a four column text file (used as Max, Min, Cycle Count, and Damage Tag values)(Damage tag option must be enabled).
 - Can manually enter values in Spectrum Data Grid.
- Sequence sub spectra
 - Paste in from excel/text file.
 - Can manually enter values in Sequence Data grid.

Spectrum Generation from Exceedance Curve

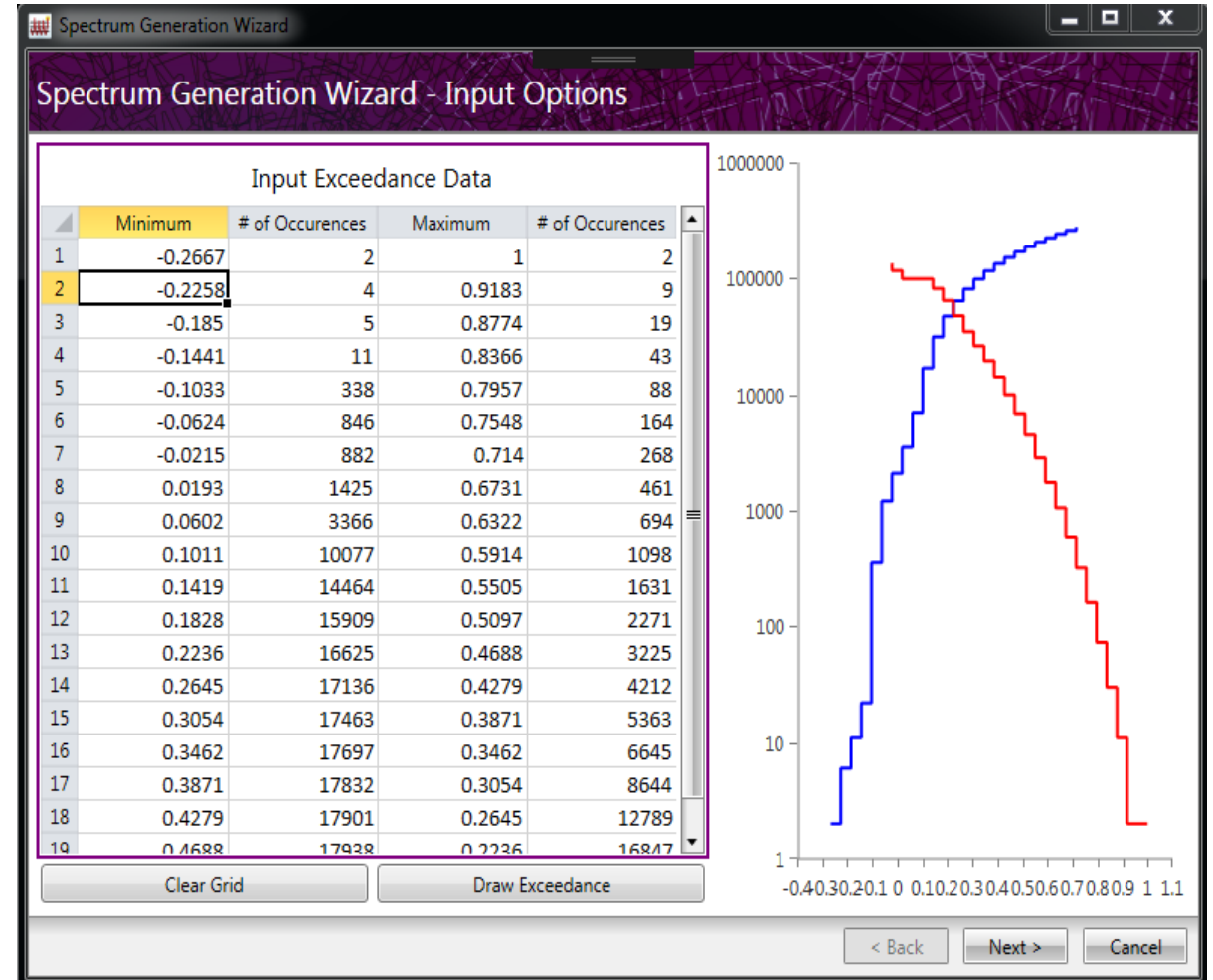
- New option to create a spectrum from exceedance curve data.
- Select the “Create Spectrum with Exceedance Data” option in the New project dialogue.

The screenshot shows a 'New Project' dialog box with the following fields and options:

- Spectrum Name: *** (text input field)
- Sub-Spectrum Label: *** (text input field)
- Description:** (text area)
- Create Options:**
 - Create Spectrum with Max/Min Data
 - Create Spectrum with Exceedance Data
- Start Wizard** (button)
- Cancel** (button)

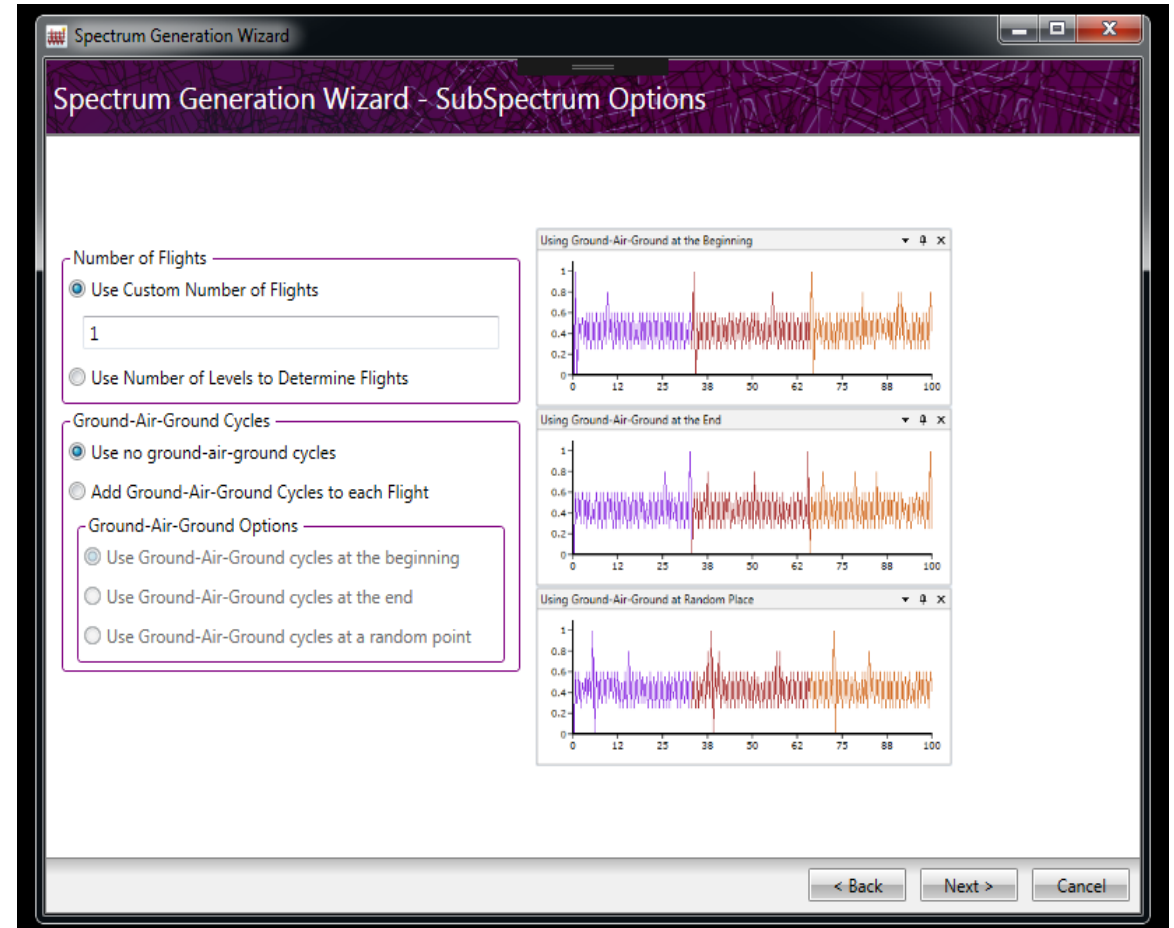
Spectrum Generation from Exceedance Curve

- Enter/Paste exceedance data into the grid (table).
- Clicking “Draw Exceedance” will create a chart visualizing the data.



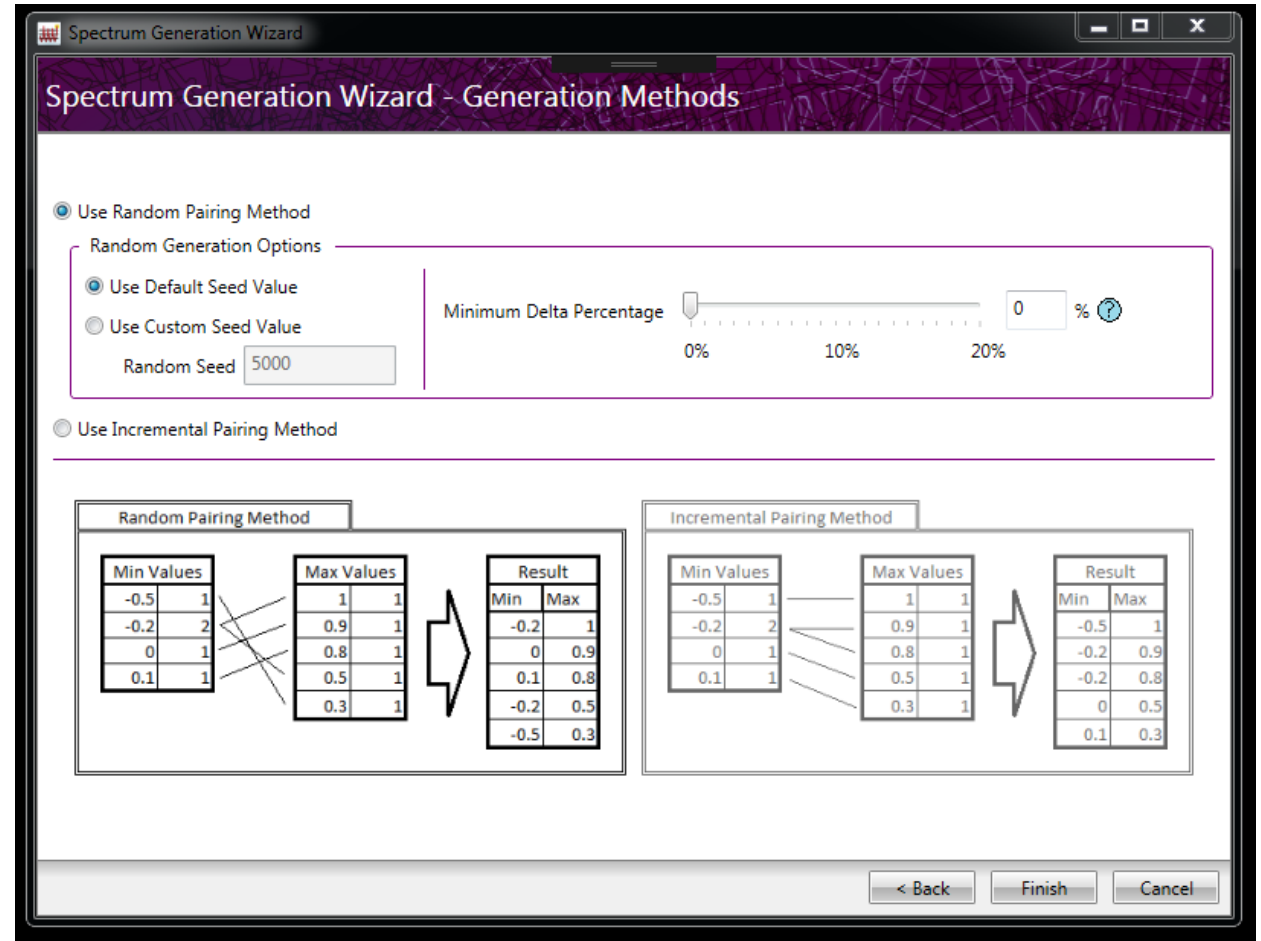
Spectrum Generation from Exceedance Curve

- 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 Generation Wizard - Generation Methods

Use Random Pairing Method

Random Generation Options

Use Default Seed Value

Use Custom Seed Value

Random Seed: 5000

Minimum Delta Percentage: 0%

Use Incremental Pairing Method

Random Pairing Method

Min Values		Max Values		Result	
Min	Max	Min	Max	Min	Max
-0.5	1	1	1	-0.2	1
-0.2	2	0.9	1	0	0.9
0	1	0.8	1	0.1	0.8
0.1	1	0.5	1	-0.2	0.5
		0.3	1	-0.5	0.3

Incremental Pairing Method

Min Values		Max Values		Result	
Min	Max	Min	Max	Min	Max
-0.5	1	1	1	-0.5	1
-0.2	2	0.9	1	-0.2	0.9
0	1	0.8	1	-0.2	0.8
0.1	1	0.5	1	0	0.5
		0.3	1	0.1	0.3

< Back Finish Cancel

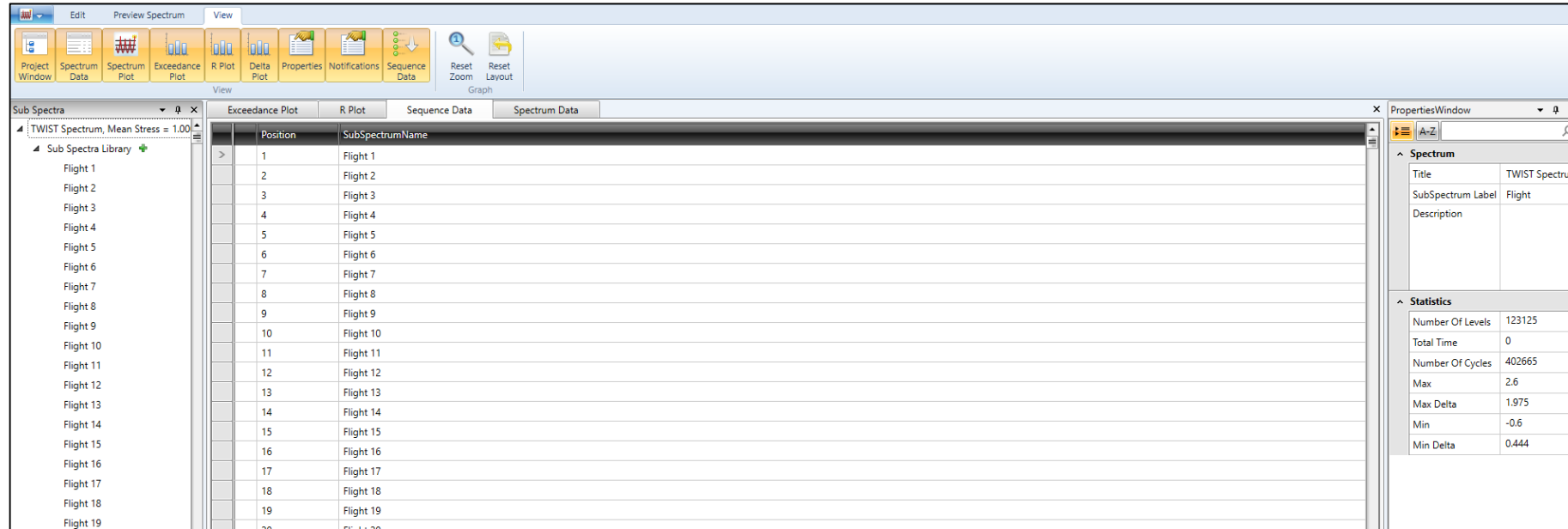
Edit existing spectrum

- Load any saved .sp3 or .spx file.
- Manually edit values in Sub Spectra through Spectrum Data grid.
- Can add tags to spectrum through options.
- Reverse, clip, truncate, normalize, denormalize, and randomize .
- Export specified sub spectra.

	Exceedance Plot	R Plot	Sequence Data	Spectrum Data	
	#	cycle	Max	Min	Cycles
>	1	1	1	-0.5	1
	2	2	1.222	0.778	2
	3	4	1.222	0.625	1
	4	5	1.222	0.778	5
	5	10	1.222	0.625	1
	6	11	1.222	0.778	6
	7	17	1.375	0.778	1
	8	18	1.222	0.625	1
	9	19	1.53	0.778	1
	10	20	1.222	0.625	2
	11	22	1.222	0.778	17
	12	39	1.375	0.778	1
	13	40	1.222	0.625	1
	14	41	1.222	0.778	1
	15	42	1.375	0.778	1
	16	43	1.375	0.625	1
	17	44	1.222	0.625	1
	18	45	1.222	0.778	2
	19	47	1.375	0.778	2
	20	49	1.222	0.625	1

Spectrum Manager GUI

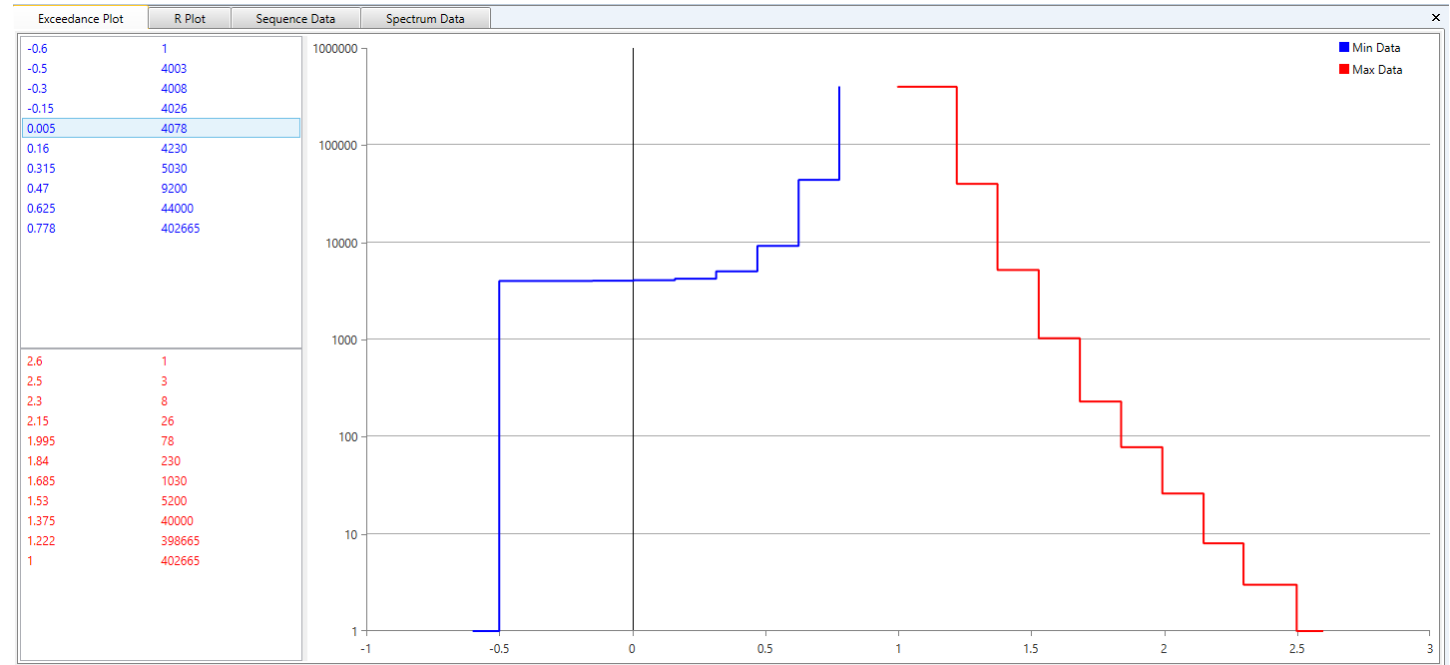
Default Layout



- Multiple display controls to view spectrum data at a glance.
- Controls are toggleable via the View tab and movable via click and drag.

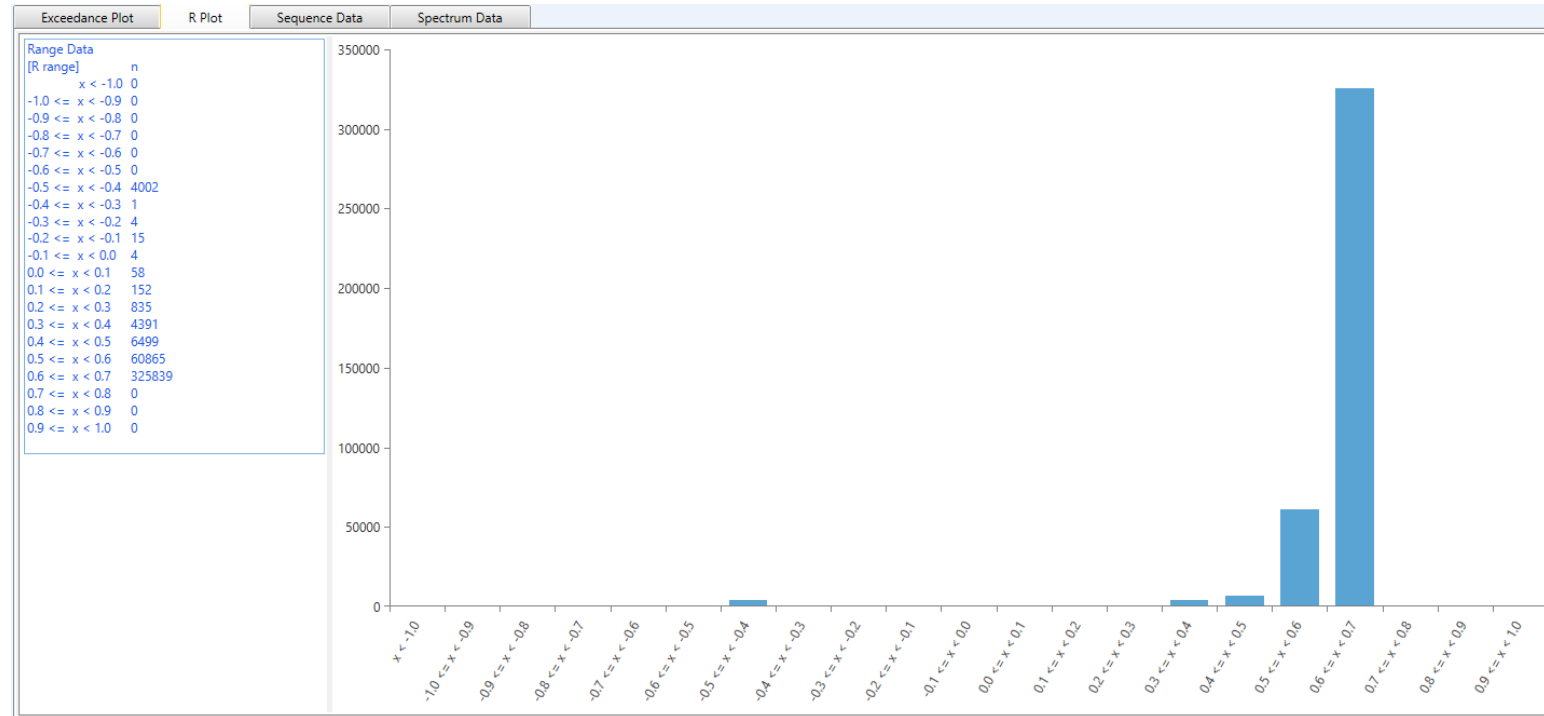
Exceedance Plot

- 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.



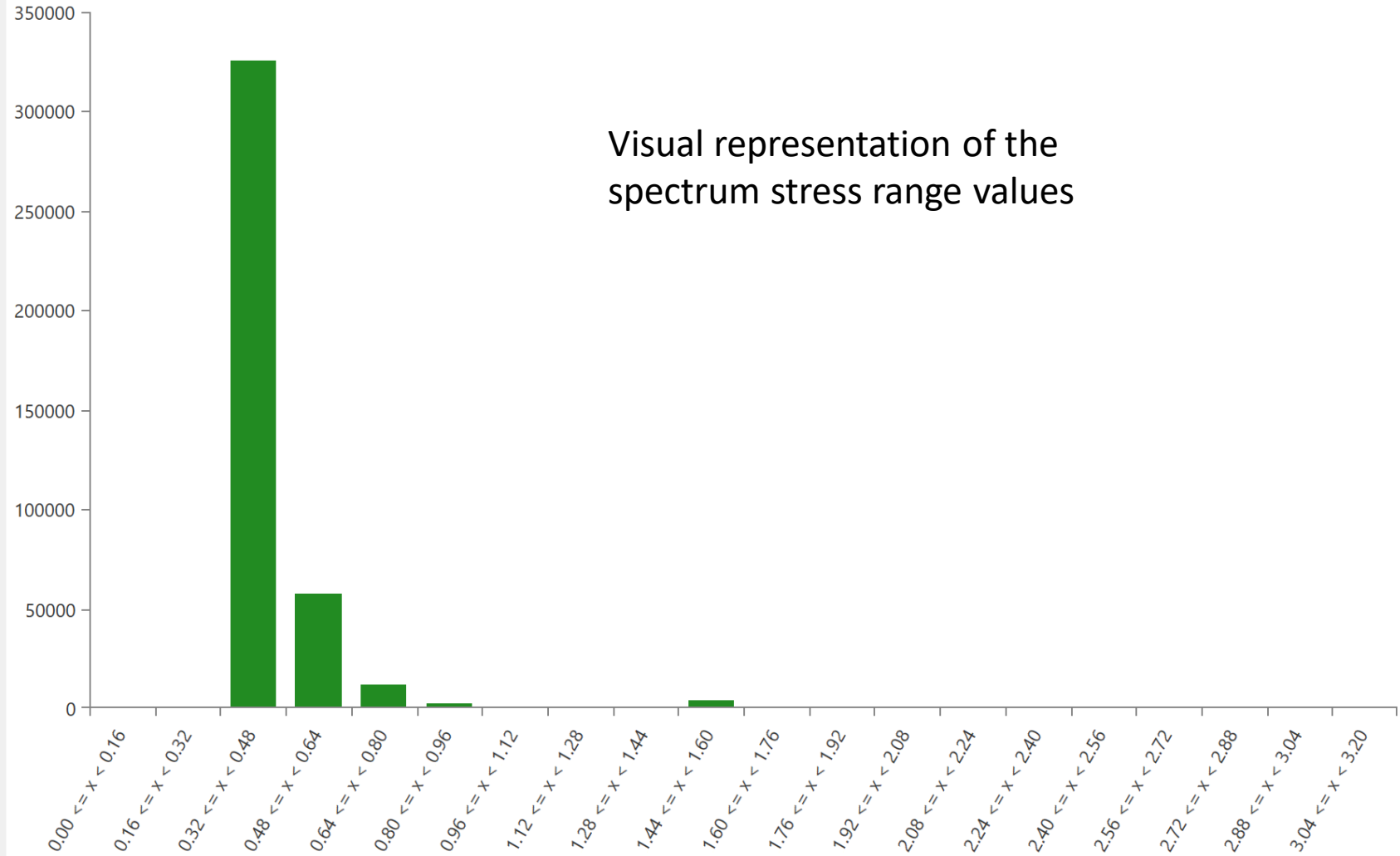
R-Plot

- 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 shown 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

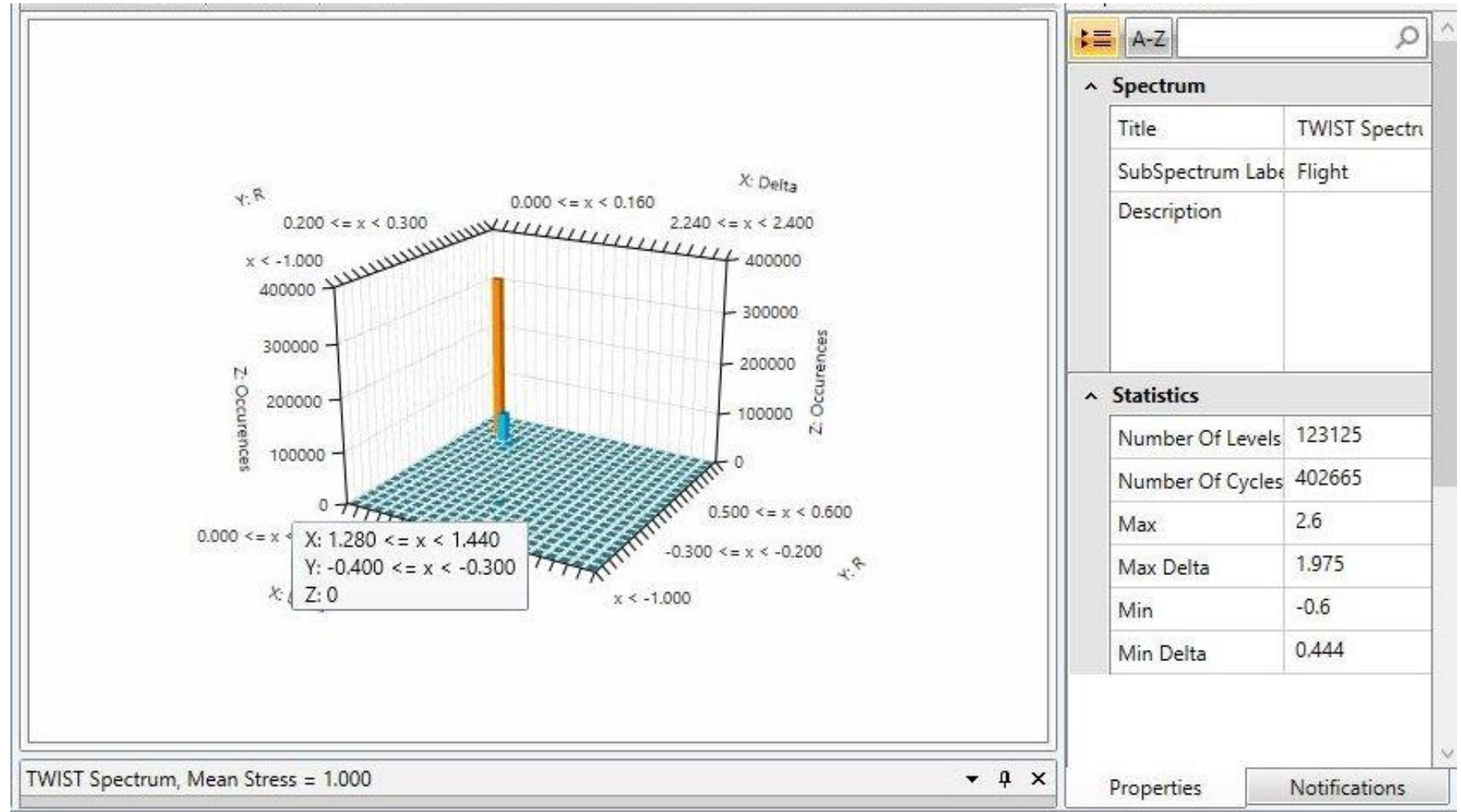
Range Data	n
[delta range]	
0.0 <= x < 0.2	0
0.2 <= x < 0.3	0
0.3 <= x < 0.5	325839
0.5 <= x < 0.6	57463
0.6 <= x < 0.8	11818
0.8 <= x < 1.0	2581
1.0 <= x < 1.1	671
1.1 <= x < 1.3	193
1.3 <= x < 1.4	63
1.4 <= x < 1.6	4020
1.6 <= x < 1.8	11
1.8 <= x < 1.9	5
1.9 <= x < 2.1	1
2.1 <= x < 2.2	0
2.2 <= x < 2.4	0
2.4 <= x < 2.6	0
2.6 <= x < 2.7	0
2.7 <= x < 2.9	0
2.9 <= x < 3.0	0
3.0 <= x < 3.2	0



3D Plot

Plots Delta vs R values vs Occurrences

Hover over desired bar to see values



Spectrum	
Title	TWIST Spectri
SubSpectrum Label	Flight
Description	

Statistics	
Number Of Levels	123125
Number Of Cycles	402665
Max	2.6
Max Delta	1.975
Min	-0.6
Min Delta	0.444

Sequence Data

- The sequence data window is where the user can place each sub spectrum 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
23	Flight 23
24	Flight 24
25	Flight 25

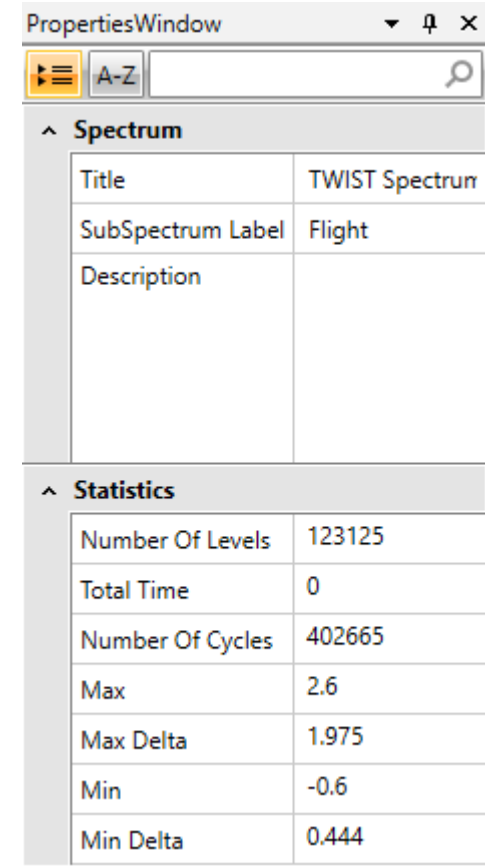
Spectrum Data

- 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		Sequence Data		Spectrum Data			
#	cycle	Max	Min	Cycles	Time	LoadType	Environment Tag	Damage Tag	Sub Spectrum Name
>	1	1	-0.5	1	0	Cyclic			Flight 1
	2	1.222	0.778	2	0	Cyclic			Flight 1
	3	1.375	0.778	1	0	Cyclic			Flight 1
	4	1.222	0.778	2	0	Cyclic			Flight 1
	5	1.222	0.625	1	0	Cyclic			Flight 1
	6	1.222	0.778	4	0	Cyclic			Flight 1
	7	1.222	0.625	1	0	Cyclic			Flight 1
	8	1.222	0.778	11	0	Cyclic			Flight 1
	9	1.375	0.778	1	0	Cyclic			Flight 1
	10	1.222	0.778	10	0	Cyclic			Flight 1
	11	1.222	0.625	1	0	Cyclic			Flight 1
	12	1.222	0.778	7	0	Cyclic			Flight 1
	13	1.222	0.625	1	0	Cyclic			Flight 1
	14	1.222	0.778	4	0	Cyclic			Flight 1
	15	1.222	0.625	1	0	Cyclic			Flight 1
	16	1.222	0.778	5	0	Cyclic			Flight 1
	17	1.375	0.778	1	0	Cyclic			Flight 1
	18	1.222	0.778	2	0	Cyclic			Flight 1
	19	1.375	0.778	1	0	Cyclic			Flight 1
	20	1.222	0.778	15	0	Cyclic			Flight 1
	21	1.222	0.625	1	0	Cyclic			Flight 1
	22	1.222	0.778	2	0	Cyclic			Flight 1
	23	1.375	0.778	1	0	Cyclic			Flight 1
	24	1.222	0.778	8	0	Cyclic			Flight 1
	25	1.53	0.778	1	0	Cyclic			Flight 1

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.



The screenshot shows a window titled "PropertiesWindow" with a search bar and a list of properties. The window is divided into two main sections: "Spectrum" and "Statistics".

Spectrum	
Title	TWIST Spectrum
SubSpectrum Label	Flight
Description	

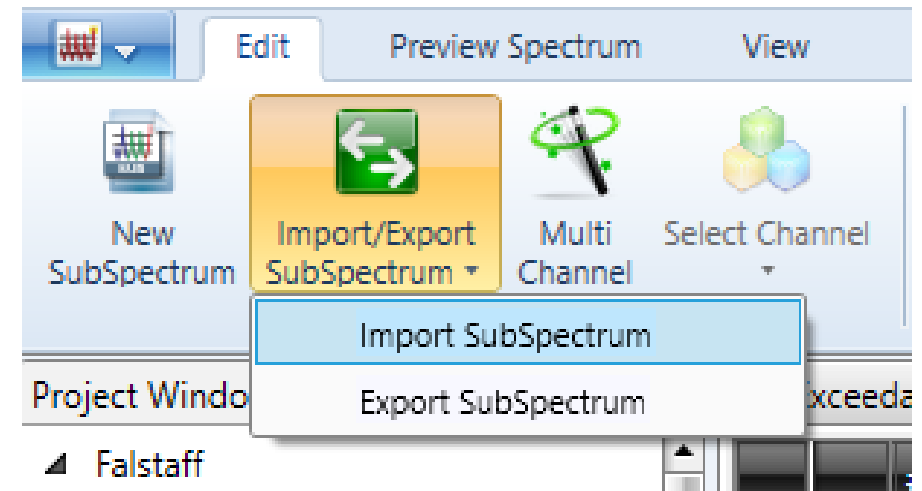
Statistics	
Number Of Levels	123125
Total Time	0
Number Of Cycles	402665
Max	2.6
Max Delta	1.975
Min	-0.6
Min Delta	0.444

Spectrum Manager Tools

Import Sub-Spectrum

Can import either .sub or .sux files

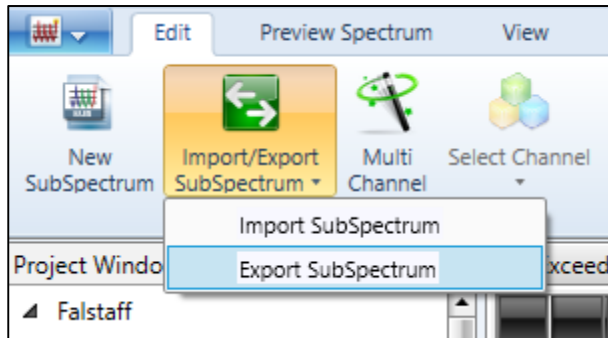
Importing a .sux file will present an option to either use the sub spectrum name included in the .sux file, or to autogenerate a name for the sub spectrum based off the project's sub spectrum label.



Note that an imported sub spectrum will not be automatically added to the sequence.

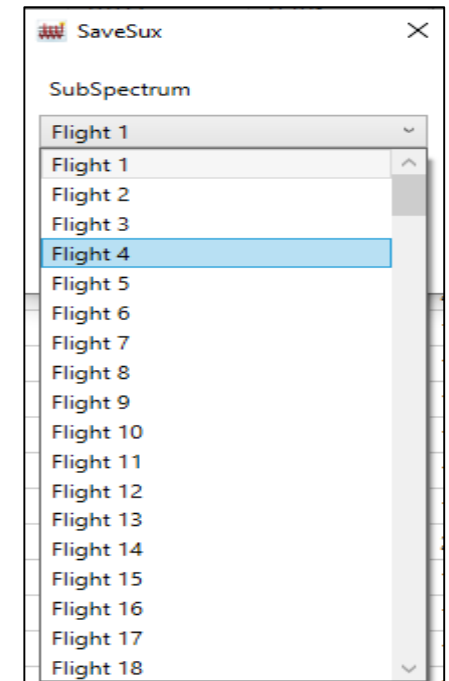
Export Sub-Spectrum

New ability to save a single sub spectrum to a .sux file.



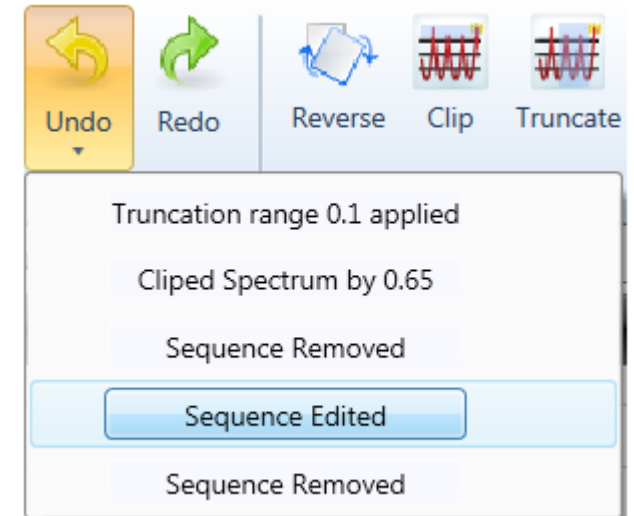
Click on the Import/Export Sub spectrum button and select Export.

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



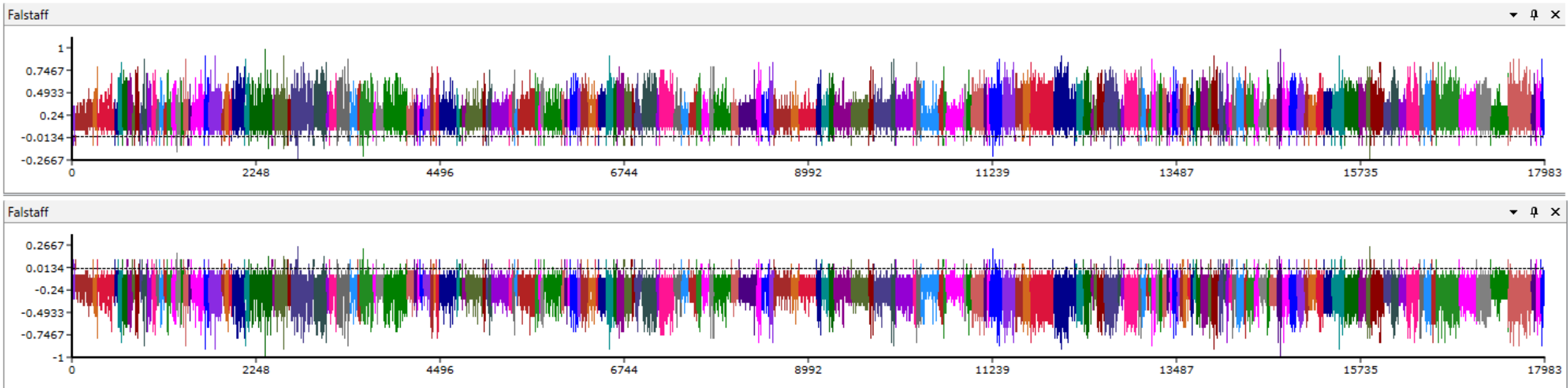
Undo/Redo

- The undo button allows the user to reverse a previous action(s) by selecting the appropriate item(s) from the undo list. The items are listed in descending chronological order, so that the most recent action performed is at the top of the list.
- The redo button restores the spectrum to the state before the last undo action was removed.



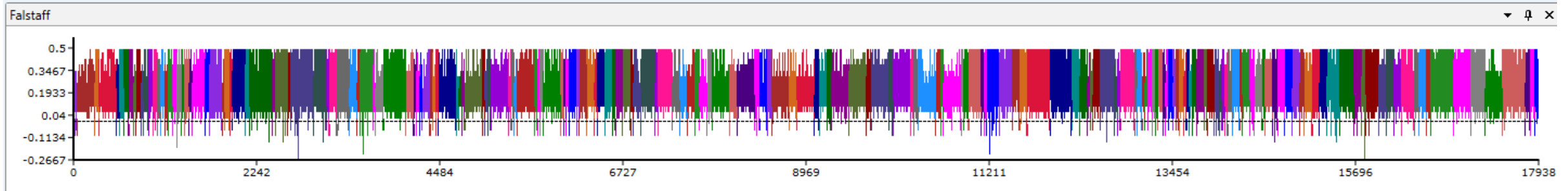
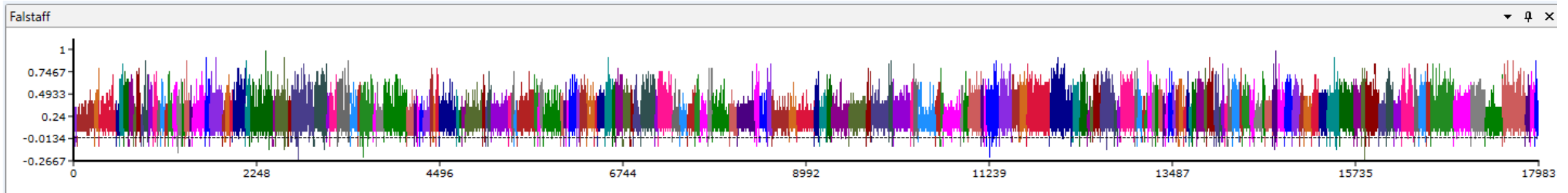
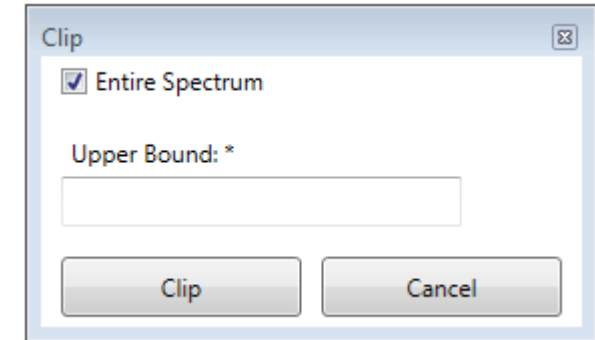
Reverse

- The reverse option 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.



Clip

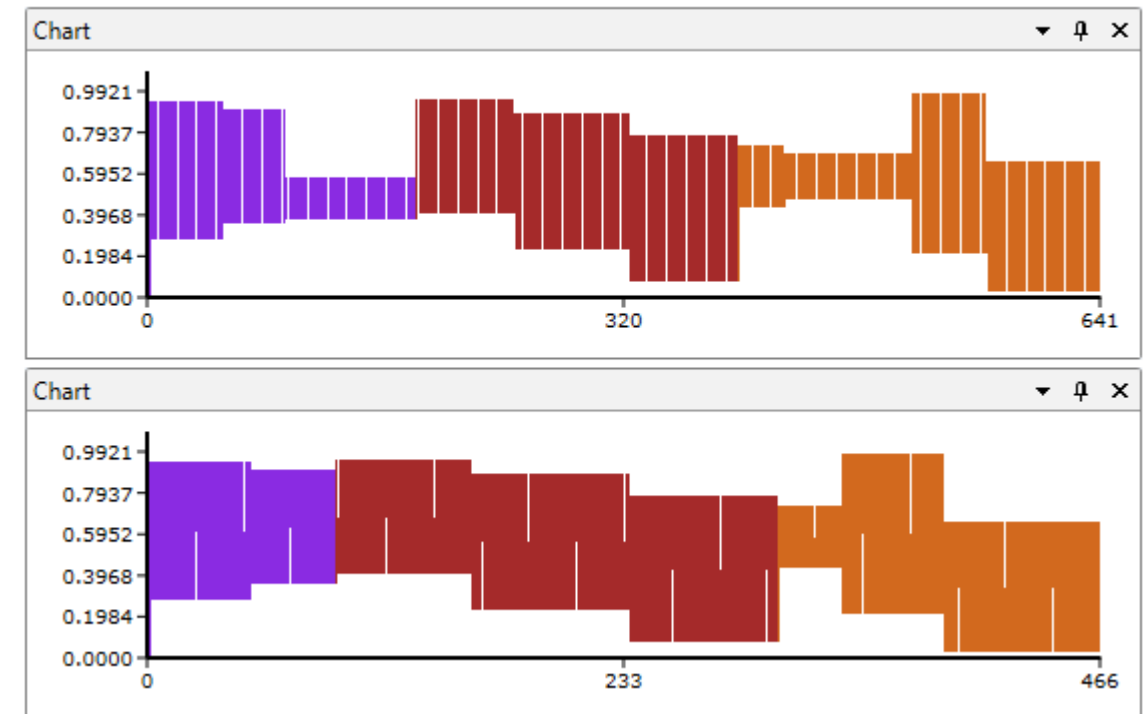
- The clip option limits the maximum stress or load value for the entire spectrum or a selected sub spectrum.
- If the max and min values of any level exceed the upper bound, that level will be removed.



Truncate

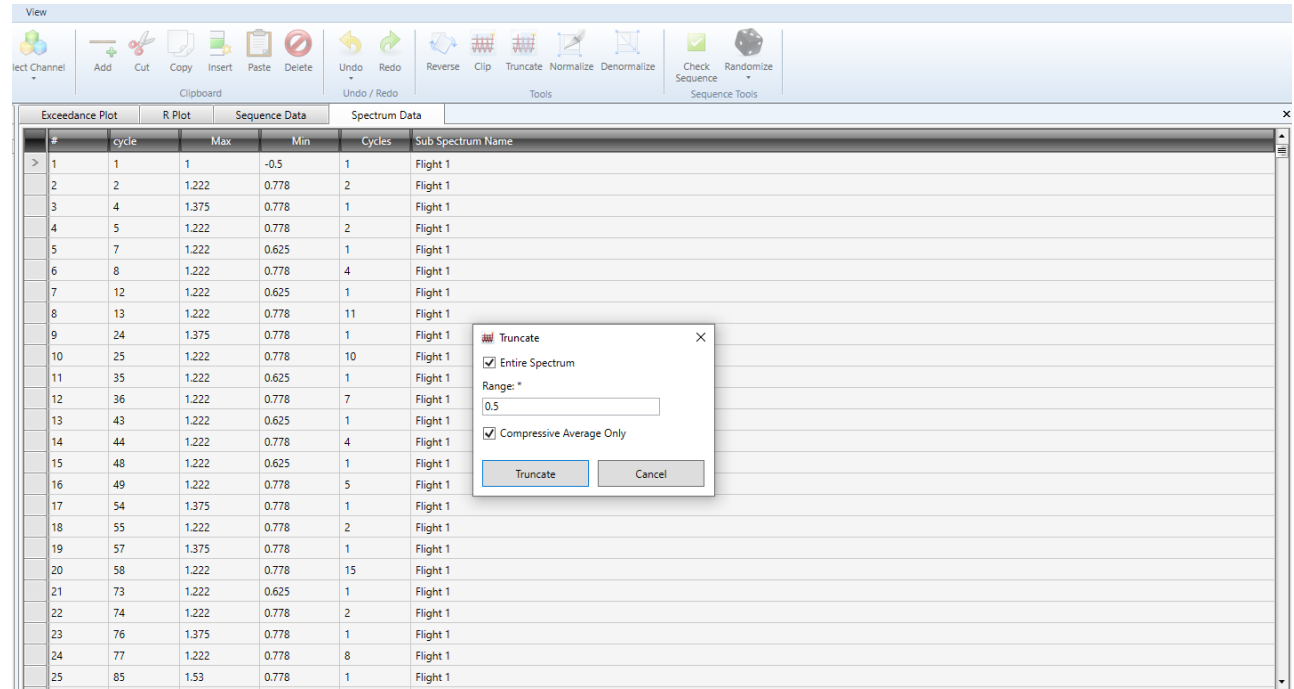
- The truncate option allows the user to set limits to the difference or "delta" between the maximum and minimum stress (or load) values for all the levels in the spectrum or a sub spectrum.
- The truncate operation ensures that any level that has a max and min with a difference less than the delta value will be deleted.
- If a sub spectrum would have all levels deleted, the user is prompted to delete the sub spectrum.

An example of a spectrum being truncated by .25:



Compressive Truncation

- New option to truncate by Compressive Average Only.
- Checking the Compressive Average box tells the truncation operation to only remove levels whose average value is negative.
- A prompt will appear to remove any resulting empty sub spectra.



The screenshot displays the AFGROW software interface. The main window shows a table with the following data:

#	cycle	Max	Min	Cycles	Sub Spectrum Name
1	1	1	-0.5	1	Flight 1
2	2	1.222	0.778	2	Flight 1
3	4	1.375	0.778	1	Flight 1
4	5	1.222	0.778	2	Flight 1
5	7	1.222	0.625	1	Flight 1
6	8	1.222	0.778	4	Flight 1
7	12	1.222	0.625	1	Flight 1
8	13	1.222	0.778	11	Flight 1
9	24	1.375	0.778	1	Flight 1
10	25	1.222	0.778	10	Flight 1
11	35	1.222	0.625	1	Flight 1
12	36	1.222	0.778	7	Flight 1
13	43	1.222	0.625	1	Flight 1
14	44	1.222	0.778	4	Flight 1
15	48	1.222	0.625	1	Flight 1
16	49	1.222	0.778	5	Flight 1
17	54	1.375	0.778	1	Flight 1
18	55	1.222	0.778	2	Flight 1
19	57	1.375	0.778	1	Flight 1
20	58	1.222	0.778	15	Flight 1
21	73	1.222	0.625	1	Flight 1
22	74	1.222	0.778	2	Flight 1
23	76	1.375	0.778	1	Flight 1
24	77	1.222	0.778	8	Flight 1
25	85	1.53	0.778	1	Flight 1

The 'Truncate' dialog box is open, showing the following options:

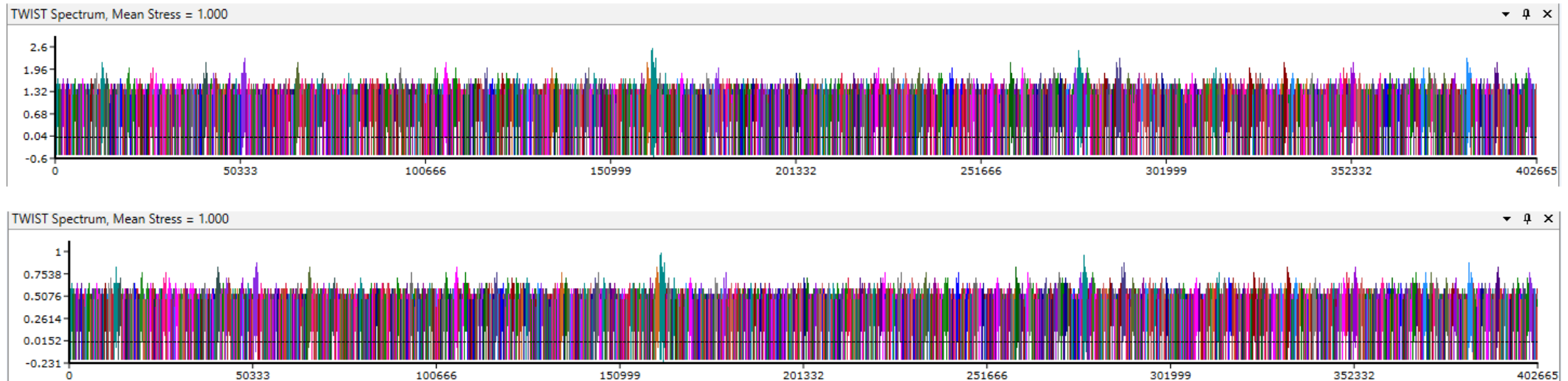
- Entire Spectrum
- Range: 0.5
- Compressive Average Only

Buttons: Truncate, Cancel

Normalize

- This option will normalize the entire spectrum by dividing 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.

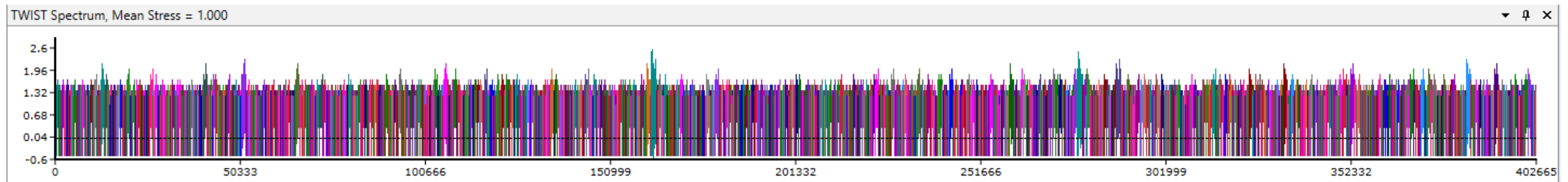
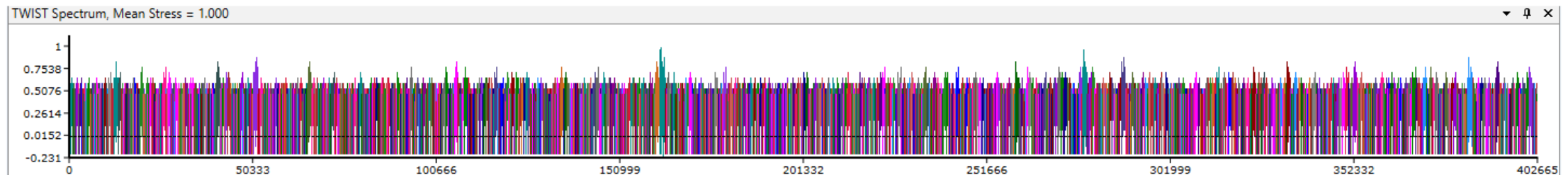
An example of a spectrum normalized by 2.6



Denormalize

- Denormalizes the entire spectrum by multiplying each max and min value by the factor entered in the denormalization dialog.

An example of a spectrum Denormalized by 2.6

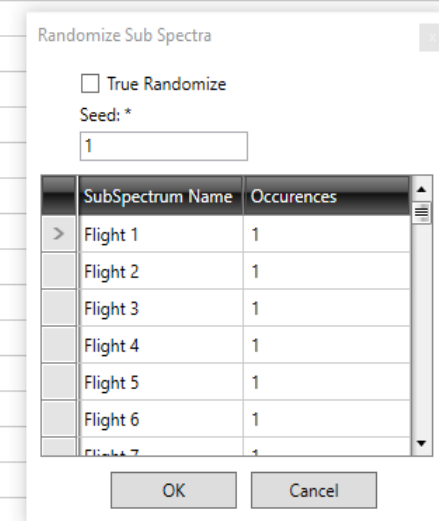
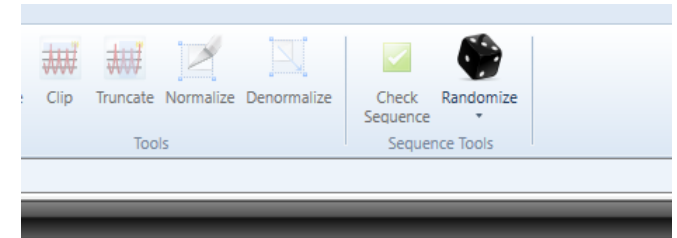


Randomize

- Two options: Randomize Sub Spectra and Randomize Sequence.
- Only available if the Sequence Data window is visible.

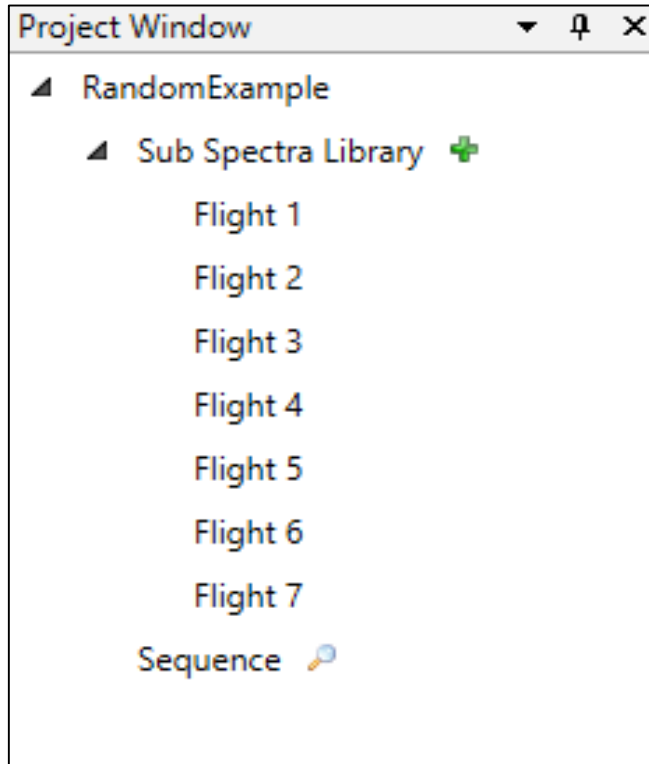
Randomize Sub Spectra

- Will arrange all sub spectra in the project into a sequence in random order.
- Each sub spectra will occur in the sequence a number of times equal to the Occurrences value next to the sub spectrum name.
- By default, the random order is determined by a seed, so that the same order can be repeated in different instances of spectrum manager, provided all other properties are the same.
- For a non-repeatable random sequence, check the “True Randomize” checkbox.
- This action will overwrite the existing sequence, if one exists.



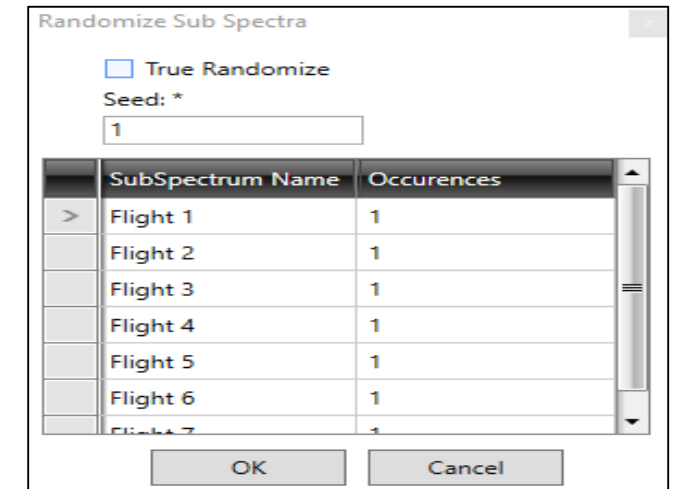
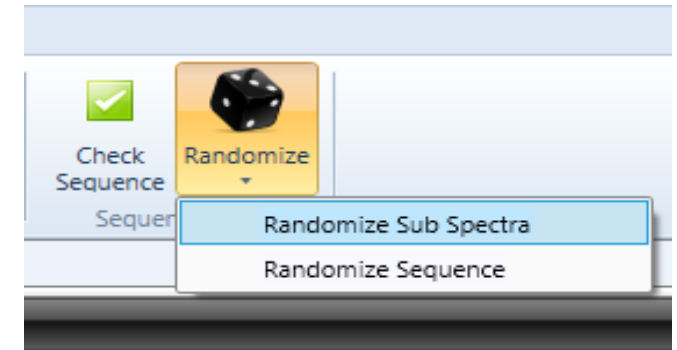
Randomize Sub Spectra

Example



Starting with a Spectrum with 7 sub spectra

Clicking Randomize and selecting Randomize Sub Spectra gives us the following

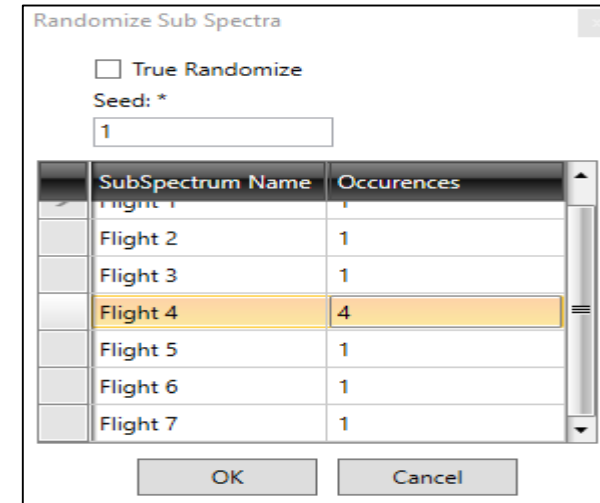


Notice that all sub spectra have an Occurrence of 1

Randomize Sub Spectra

Example Cont.

Changing the number of occurrences for Flight 4 to 4 and leaving the rest at 1 will result in a sequence that has four occurrences of Flight 4 and a single occurrence of all other flights.



Project Window	Exceedance Plot	R Plot	Sequence Data	Spectrum Data																						
<ul style="list-style-type: none"> RandomExample <ul style="list-style-type: none"> Sub Spectra Library + <ul style="list-style-type: none"> Flight 1 Flight 2 Flight 3 Flight 4 Flight 5 Flight 6 Flight 7 Sequence 🔍 			<table border="1"> <thead> <tr> <th>Position</th> <th>SubSpectrumName</th> </tr> </thead> <tbody> <tr><td>1</td><td>Flight 7</td></tr> <tr><td>2</td><td>Flight 4</td></tr> <tr><td>3</td><td>Flight 5</td></tr> <tr><td>4</td><td>Flight 2</td></tr> <tr><td>5</td><td>Flight 4</td></tr> <tr><td>6</td><td>Flight 4</td></tr> <tr><td>7</td><td>Flight 6</td></tr> <tr><td>8</td><td>Flight 4</td></tr> <tr><td>9</td><td>Flight 1</td></tr> <tr><td>10</td><td>Flight 3</td></tr> </tbody> </table>	Position	SubSpectrumName	1	Flight 7	2	Flight 4	3	Flight 5	4	Flight 2	5	Flight 4	6	Flight 4	7	Flight 6	8	Flight 4	9	Flight 1	10	Flight 3	
Position	SubSpectrumName																									
1	Flight 7																									
2	Flight 4																									
3	Flight 5																									
4	Flight 2																									
5	Flight 4																									
6	Flight 4																									
7	Flight 6																									
8	Flight 4																									
9	Flight 1																									
10	Flight 3																									

Randomize Sequence

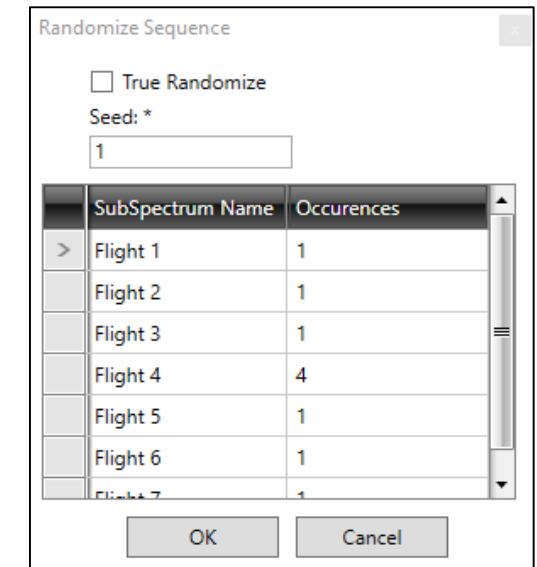
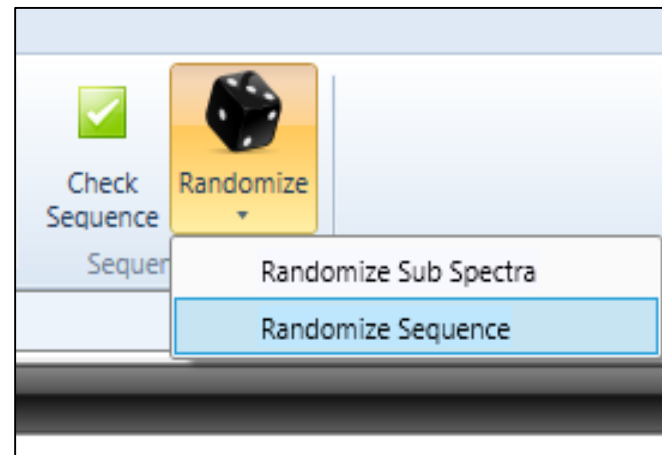
- Will arrange all sub spectra in the current sequence into a new sequence in random order.
- There must be an existing sequence.
- Each sub spectra will be appear in the sequence a number of times equal to the Occurrences value next to the sub spectrum name.
- The ordering works the same way as Randomize Sub Spectra, based on a seed value with the option to truly randomize.
- This action will replace the existing sequence, if one exists.

Randomize Sequence Example

Exceedance Plot	R Plot	Sequence Data	Spectrum Data
		Position	SubSpectrumName
		1	Flight 1
		2	Flight 2
		3	Flight 3
		4	Flight 4
		5	Flight 4
		6	Flight 4
		7	Flight 4
		8	Flight 5
		9	Flight 6
		10	Flight 7

Starting with a sequence of 7 sub spectra, with Flight 4 being sequenced four times and the rest being sequenced only once.

Clicking Randomize and selecting Randomize Sequence gives us the following.



Randomize Sequence

Example Cont.

Exceedance Plot		R Plot	Sequence Data	Spectrum Data
	Position	SubSpectrumName		
	1	Flight 7		
	2	Flight 4		
	3	Flight 5		
	4	Flight 2		
	5	Flight 4		
	6	Flight 4		
	7	Flight 6		
	8	Flight 4		
	9	Flight 1		
	10	Flight 3		

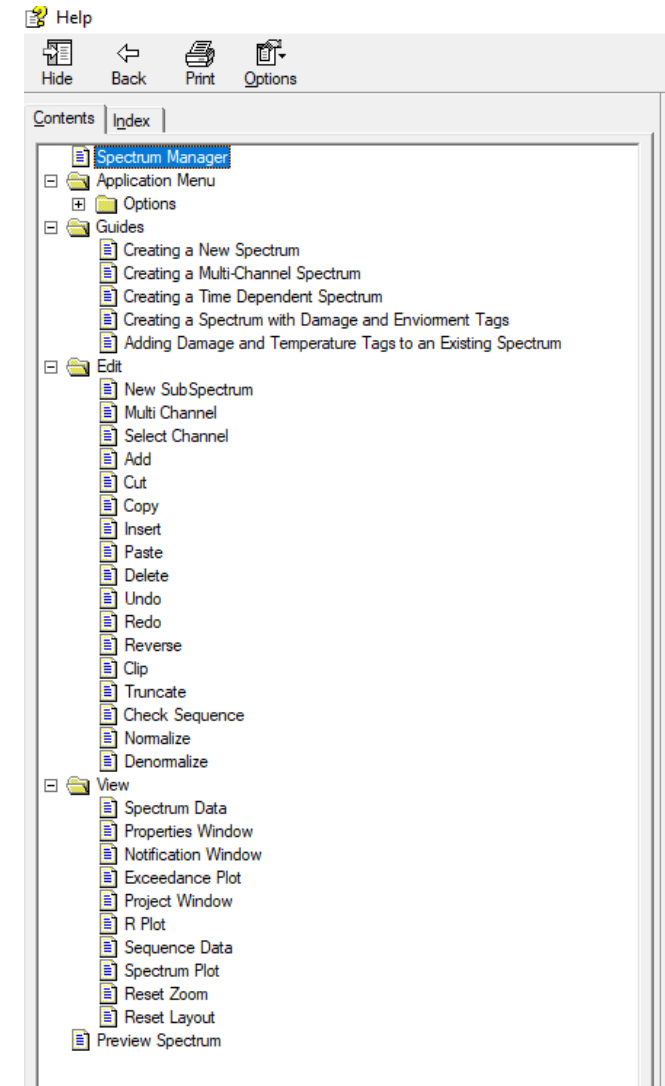
Note that the order matches the previous example exactly, this is because we used the same seed value and the same number of occurrences for each sub spectrum.

If we go back to Randomize Sequence and leave all values the same but change the seed to 2, we get the following sequence instead.

Exceedance Plot		R Plot	Sequence Data	Spectrum Data
	Position	SubSpectrumName		
	1	Flight 3		
	2	Flight 6		
	3	Flight 5		
	4	Flight 4		
	5	Flight 4		
	6	Flight 1		
	7	Flight 7		
	8	Flight 2		
	9	Flight 4		
	10	Flight 4		

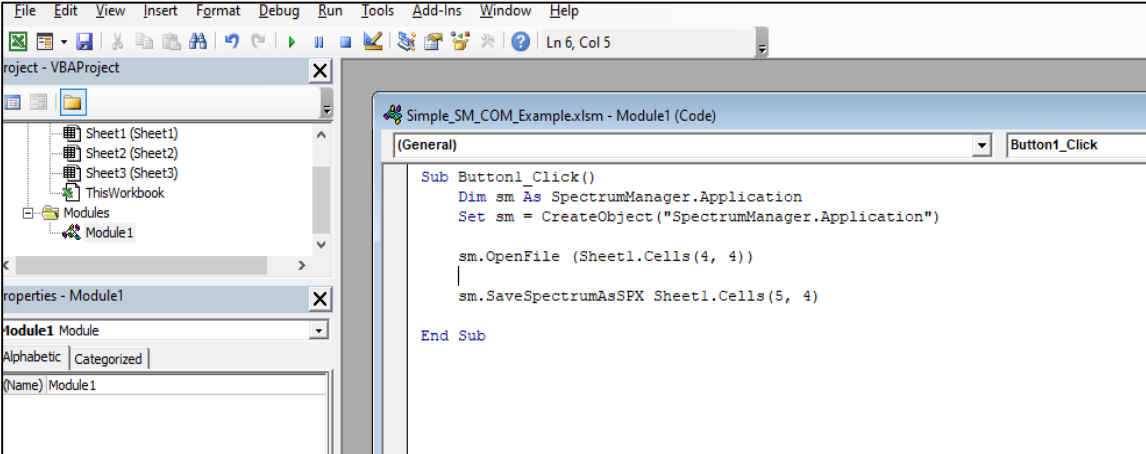
Context Sensitive Help

- Contains details on every current feature of Spectrum Manager.
- Also contains guides detailing how to go 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

- Perform most 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.



```
File Edit View Insert Format Debug Run Tools Add-Ins Window Help
project - VBAProject
Sheet1 (Sheet1)
Sheet2 (Sheet2)
Sheet3 (Sheet3)
ThisWorkbook
Modules
Module1
properties - Module1
Module1 Module
Alphabetic | Categorized
(Name) Module1

Simple_SM_COM_Example.xlsm - Module1 (Code)
[General] Button1_Click

Sub Button1_Click()
    Dim sm As SpectrumManager.Application
    Set sm = CreateObject("SpectrumManager.Application")

    sm.OpenFile (Sheet1.Cells(4, 4))
    sm.SaveSpectrumAsSPX Sheet1.Cells(5, 4)
End Sub
```

Beta Tester Reviews

- “The spectrum generation wizard – exceedance data input – works very well. I generated a subspectra from exceedance data, which I was able to import in Afgrow and grow a crack. I compared the results with the CA crack growth assumptions to verify our approach. I had no issues and found the interface to be well thought out and easy to use.”
- “User friendly GUI design which helps me got used to this software very fast.”
- “Some basic statistics can be visualized instantly in the view section. Normalization and denormalization function is helpful if normalization is done with respect to the maximum stress.”

Long Term Future Development Plans

- Spectrum Cycle Counting
- Saving uncounted spectrum with count
- Improved Undo/Redo
- Spectrum Severity Comparison
- Combining exceedance curves

Conclusion

- AFGROW Spectrum Manager is a user-friendly Windows based software application that uses a visual approach to develop and modify structural loading spectra for damage tolerance analysis. It allows the user to define the max and min stress (or load) values for the spectrum and modify the data in various ways.

Questions/Comments?