

APU Spectrum Analyzer



User Manual
v5.3.1

Table of Contents

Table of Contents	2
1. Introduction	4
2. Parameters	4
2.1. Spectrum	4
2.1.1. Presets	5
2.1.2. Channel mode	5
2.1.3. Visualization	5
2.1.4. FFT scale type	5
2.1.5. FFT window type	6
2.1.6. FFT window size	6
2.1.7. Kaiser beta	6
2.1.8. Raster type	6
2.1.9. Raster orientation	6
2.1.10. Sidechain	6
2.1.11. Live monitoring	6
2.1.12. Reset meters	6
2.1.13. Open file	6
2.2. Visualization	7
2.2.1. Auto range	7
2.2.2. Visual range presets	7
2.2.3. Loudness range	7
2.2.4. Snapshots	8
2.2.5. Layout options	8
2.2.6. Layout source mode	8
2.2.7. Layout target mode	9
2.2.8. Layout output mode	9
2.2.9. Delta field type	9
2.2.10. Bits per pixel	9
2.2.11. Milk Mode	9
2.2.12. Bar Mode	9
2.2.13. Bucket size	9
2.2.14. Histogram hold	9
2.2.15. Delta X/Y/T	10
2.2.16. Delta field	10
2.2.17. Shader params	10
2.2.18. Show contour	10
2.2.19. Panel params	10
2.2.20. History length	10
2.2.21. Show peak meter	10
2.2.22. Show spectrum peak	10
2.2.23. Show axis labels	10
2.2.24. Show axis lines	11
2.2.25. Show alt axis labels	11
2.2.26. Show alt axis lines	11
2.3. Theme	11
2.3.1. Theme presets	12
2.3.2. Source color	12
2.3.3. Normal color	12
2.3.4. Target color	12
2.3.5. Output color	13
2.3.6. Textures	13
2.4. Settings	13
2.4.1. BPM	13
2.4.2. Host BPM	13
2.4.3. Velocity sensitive knobs	14
2.4.4. Load preset visuals	14
2.4.5. UI Scaling	14
2.4.6. Axis Scaling	14
2.4.7. Dark mode	14
2.4.8. Blocksize	14
2.4.9. Delay compensation	14
2.5. Update	14
2.6. About	14
3. Standalone CLI	15
4. Glossary	15
4.1. Range sliders	15
4.2. Histogram	15
4.3. Source	16
4.4. Target	16
4.5. Output	16

5. Credits	16
5.1. MIT License (libebur128)	16
5.2. MIT License (melatonin_blur)	17
5.3. FFTPACK License (pffft)	17

1. Introduction

[APU Spectrum Analyzer](#) is a spectral analyzer plug-in released by [APU Software, LLC](#). Here you can read about the different features and parameters available with the plug-in.

2. Parameters

This software supports a variety of parameters, most of which can be adjusted in real-time. This section provides an overview of each parameter, with each subsection detailing the parameters for the associated tab in the user interface. From within the user interface, you can also hover the mouse over a slider, combo-box, or checkbox to see a popup description of the parameter.

2.1. Spectrum



The spectrum tab contains configuration and visualization for spectral analysis. This section details each of the individual parameters and components.

2.1.1. Presets

Spectrum Analyzer's presets combo-box contains a collection of basic presets.

You can configure whether or not to [load preset visuals](#) when switching between presets, and you can switch between loading dark or light themes through the [dark mode](#) parameter.

Currently, the following presets are available ("Full Reset" restores all default parameter values):

- Full Reset
- Live Monitoring - Standard Reference
- Live Monitoring - Deep Range
- Live Monitoring - Full Range
- Live Monitoring - Auto Range
- Full Histogram - Standard Reference
- Full Histogram - Deep Range
- Full Histogram - Full Range
- Full Histogram - Auto Range
- Visualization - Spectrum (Spiral)
- Visualization - Spectrum (Swirl)
- Visualization - Spectrum (Polar)
- Visualization - Spectrum (Wave)

2.1.2. Channel mode

The channel mode parameter determines which channel the visualizer shows. Channel-linked shows the average of all channels, while channel-select shows only the selected channel.

2.1.3. Visualization

The visualization component displays a continuously evolving real-time view of your source spectrum over time.

You can hover the mouse over a bucket to see the frequency range and loudness the bucket corresponds to.

Detailed visualization settings can be adjusted from the [visualization](#) tab, with some features also available by right clicking on the visualization component.

You can double-click the visualization component to resize and hide everything else.

2.1.4. FFT scale type

The FFT scale type parameter determines the frequency scale used for the visualization. The following options are available:

- Linear: Linear frequency scale with frequency labels
- Log: Logarithmic frequency scale with frequency labels
- Note: Logarithmic frequency scale with note labels

2.1.5. FFT window type

The FFT window type parameter determines the window type used for the spectral histogram's FFT. The following options are available:

- Rect: Rectangular window
- Hann: Hann window
- Hamming: Hamming window
- Blackman: Blackman window
- Kaiser: Kaiser window

When using the Kaiser window, the [Kaiser beta](#) parameter is used to determine the window shape.

2.1.6. FFT window size

The FFT window size parameter determines the size of the spectral histogram's FFT window.

The FFT window size determines a trade-off between frequency resolution and time resolution. A larger window size provides better frequency resolution, while a smaller window size provides better time resolution.

2.1.7. Kaiser beta

The Kaiser beta parameter determines the shape of the window when Kaiser [FFT window type](#) is selected.

2.1.8. Raster type

The raster type parameter allows you to enable/disable the spectral histogram raster visualization.

2.1.9. Raster orientation

The raster orientation parameter allows you to specify the rotation of the raster visualization. You can select between horizontal and vertical orientations.

2.1.10. Sidechain

The sidechain toggle allows you to enable/disable sidechain processing. When enabled, the target signal will come from the plug-in's sidechain channel(s). This allows you to monitor an external source, which can be used for example to compare the sidechain signal to the source signal.

2.1.11. Live monitoring

The live monitoring option enables continuous spectral analysis and visualization. When disabled, only arrangement/timeline playback will be monitored. This can help ensure the accuracy of spectral measurements.

2.1.12. Reset meters

The reset button resets the spectral [histogram](#).

2.1.13. Open file

The "Open file ..." button allows you to perform analysis on any supported audio file. This will also clear all previous [histogram](#) visualizations.

This feature automatically switches to [histogram](#) view after analyzing the file, which allows you to quickly view the spectrum of the audio material.

After opening an audio file, press the "Close file" button to return to live monitoring.

2.2. Visualization



The visualization tab contains parameters related to real-time configuration of Spectrum Analyzer's visualizations. This section describes these various settings.

2.2.1. Auto range

The auto range parameter enables or disables the visualization's auto range finding capabilities. This feature operates by analyzing the continuous histogram at each frame to determine a reasonable range for that moment in time. This range is then followed and adjusted smoothly over time.

2.2.2. Visual range presets

Visual range presets are provided for convenience to quickly adjust the dB range of the visualizer.

Currently, the following visual range presets are available:

- Auto Range (Global)
- Auto Range (Per Panel)
- Standard Reference (≥ -90)
- Deep Range (≥ -120)
- Full Range (≥ -160)
- Custom Range ...

2.2.3. Loudness range

The loudness range parameter allows the visualization loudness range to be set manually. In order for this range to be enabled and used, the [visual range presets](#) parameter must be set to "Custom Range"

See [range sliders](#) for information about range sliders in general.

2.2.4. Snapshots

The snapshots feature allows you to take a snapshot of the current histogram. This can be useful for comparing histograms.

Each source/target/output signal has its own snapshot. The snapshots are persisted with plug-in state, so they will be available when you reopen the project.

Snapshots can be operated using the popup menu or via keyboard shortcuts.

The following snapshot parameters are available:

- Save/clear snapshot (saves or clears the current histogram)
 - Source = Cmd + 1
 - Target = Cmd + 2
 - Output = Cmd + 3
- Fill snapshot (fills the area under the snapshot)
 - Source = Cmd + Alt + 1
 - Target = Cmd + Alt + 2
 - Output = Cmd + Alt + 3
- Show/hide snapshot (shows or hides the snapshot in the visualization)
 - Source = Cmd + Shift + 1
 - Target = Cmd + Shift + 2
 - Output = Cmd + Shift + 3

On Windows, use Ctrl instead of Cmd.

2.2.5. Layout options

The options menu allows you to configure the layout of the visualization. The following options are available:

- [layout source mode](#) : Specifies the layout mode for the [source](#) signal.
- [layout target mode](#) : Specifies the layout mode for the [target](#) signal.
- [layout output mode](#) : Specifies the layout mode for the [output](#) signal.
- [raster type](#) : Specifies the type of raster visualization.
- [raster orientation](#) : Specifies the orientation of the raster visualization.
- [show peak meter](#) : Specifies whether or not to show peak meter.
- [show spectrum peak](#) : Specifies whether or not to show spectral peak.
- [show axis labels](#) : Specifies whether or not to show loudness axis labels.
- [show axis lines](#) : Specifies whether or not to show loudness axis lines.
- [show alt axis labels](#) : Specifies whether or not to show frequency axis labels.
- [show alt axis lines](#) : Specifies whether or not to show frequency axis lines.

Each layout mode has an AUTO option which automatically selects the best layout mode based on the current context.

2.2.6. Layout source mode

The layout source mode parameter allows you to configure the layout of the visualization's source panel.

Currently, the following layout source modes are available:

- None (No source panel is displayed)
- Auto (Automatically selects the best layout mode based on the current context)
- Source only (Draws just the [source](#) signal)
- Source over Target (Draws the [target](#) signal first, then the [source](#) signal on top)
- Source over Output (Draws the [output](#) signal first, then the [source](#) signal on top)

2.2.7. Layout target mode

The layout target mode parameter allows you to configure the layout of the visualization's target panel.

Currently, the following layout target modes are available:

- None (No target panel is displayed)
- Auto (Automatically selects the best layout mode based on the current context)
- Target only (Draws just the [target](#) signal)
- Target over Source (Draws the [source](#) signal first, then the [target](#) signal on top)
- Target over Output (Draws the [output](#) signal first, then the [target](#) signal on top)

2.2.8. Layout output mode

The layout output mode parameter allows you to configure the layout of the visualization's output panel.

Currently, the following layout output modes are available:

- None (No output panel is displayed)
- Auto (Automatically selects the best layout mode based on the current context)
- Output only (Draws just the [output](#) signal)
- Output over Source (Draws the [source](#) signal first, then the [output](#) signal on top)
- Output over Target (Draws the [target](#) signal first, then the [output](#) signal on top)

2.2.9. Delta field type

The delta field type parameter allows you to specify the type of delta field used by the visualization.

The delta field is basically a mapping from each source pixel on the screen to a destination pixel. Pixel shaders are used to iteratively apply this delta field using interpolation and some light dithering effects. This feature is purely for aesthetic purposes and has no effect on the audio.

[Raster type](#) effects are drawn into the delta field on each frame.

2.2.10. Bits per pixel

The bits-per-pixel parameter determines the number of bits per pixel to use when rendering visualizations. The default bpp is the best performing. You can increase bpp to improve visual quality.

2.2.11. Milk Mode

The “Milk mode” parameter enables/disables milk mode. In milk mode, the visualizations will look smoother and behave more like a screensaver at the expense of accuracy. This feature is purely for entertainment purposes.

2.2.12. Bar Mode

The “Bar mode” parameter enables/disables bar mode. In bar mode, the visualizations will be drawn as vertical bars instead of sloped lines. This feature is purely for aesthetic purposes and has no effect on the audio.

2.2.13. Bucket size

The bucket size parameter determines the size in pixels of visualization buckets (rectangles).

2.2.14. Histogram hold

The histogram hold parameter enables or disables “hold” mode for the [histogram](#) raster types. While “hold” mode is enabled, the histogram will continuously accumulate measurements indefinitely. This can be used to capture a full duration view of your source audio. This allows you to easily adjust ranges to target to a specific region of the full dynamic range.

The histogram will still continuously accumulate measurements while “hold” mode is disabled, but for each new measurement the oldest measurement in history is replaced. This results in a continuously evolving histogram of duration specified by the [history length](#) parameter.

2.2.15. Delta X/Y/T

The delta X/Y/T parameters are provided to the visualization [delta field](#) in order to manipulate the delta field in real-time. The exact behavior of each parameter depends on the active [delta field type](#).

2.2.16. Delta field

The delta field parameter allows you to enable or disable the visualization delta field.

The delta field is basically a mapping from each source pixel on the screen to a destination pixel. Pixel shaders are used to iteratively apply this delta field using interpolation and some light dithering effects. This feature is purely for aesthetic purposes and has no effect on the audio.

[Raster type](#) effects are drawn into the delta field on each frame.

2.2.17. Shader params

The shader parameters control various aspects of visualization rendering. The following options are available:

- Shader param 1: Delta field fade rate. Lower values leave longer trails.
- Shader param 2: Curve fill transparency. Lower values make the curve more transparent, leaving only the edge(s) visible.
- Shader param 3: Curve edge thickness. Lower values make the edge thinner.

2.2.18. Show contour

The show contour parameter allows you to enable or disable contour drawing in the visualization.

Show contour applies to all panels in the visualization, including [source](#), [target](#), and [output](#) signals.

2.2.19. Panel params

The panel parameters control various aspects of panel rendering. The following options are available:

- Panel param 1: Panel alpha (transparency), 0.0 to remove panel completely
- Panel param 2: Panel hue (rotates through normal, source, target, output).
- Panel param 3: Panel hue intensity

2.2.20. History length

The history length parameter allows you to change the duration of visualization history. This history is a rolling-window where each new loudness sample pushes out the oldest sample, maintaining a continuous history length with the duration you've configured here. Note that this setting applies both to [history](#) and [histogram](#) raster types.

During [histogram hold](#) the histogram has an effectively infinite history length.

2.2.21. Show peak meter

The show peak meter parameter allows you to enable or disable peak meter drawing next to the visualizer.

2.2.22. Show spectrum peak

The show spectrum peak parameter allows you to enable or disable spectral peak drawing.

2.2.23. Show axis labels

The show axis labels parameter allows you to enable or disable axis drawing in the visualization.

The axis is scaled relative to the [loudness range](#), which can be manual or [auto range](#).

2.2.24. Show axis lines

The show axis lines parameter allows you to enable or disable axis line drawing in the visualization.

axis lines are drawn at each [Show axis labels](#).

2.2.25. Show alt axis labels

The show axis labels parameter allows you to enable or disable frequency axis drawing in the visualization.

2.2.26. Show alt axis lines

The show axis lines parameter allows you to enable or disable frequency axis line drawing in the visualization.

axis lines are drawn at each [Show alt axis labels](#).

2.3. Theme



The theme tab contains parameters related to color themes. Here you can select between the bank of color theme presets, or configure the individual colors yourself.

2.3.1. Theme presets

The theme presets combo-box allows you to switch between a variety of theme presets. Each theme has a light and dark variation. Switching between theme presets will load values into [source color](#), [normal color](#), [target color](#) and [output color](#).

Currently, the following themes are available:

- APU Default
- APU Red
- APU Vermilion
- APU Orange
- APU Amber
- APU Yellow
- APU Lime
- APU Chartreuse
- APU Harlequin
- APU Green
- APU Erin
- APU Spring
- APU Aquamarine
- APU Cyan
- APU Turquoise
- APU Azure
- APU Cerulean
- APU Blue
- APU Indigo
- APU Violet
- APU Purple
- APU Magenta
- APU Raspberry
- APU Rose
- APU Crimson

2.3.2. Source color

The source color parameters control the red, green, and blue components of the [source](#) color.

The source color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element relates to the [source](#) signal in some way. This color is expected to contrast against the [normal color](#) to some extent.

2.3.3. Normal color

The normal color parameters control the red, green, and blue components of the “normal” color.

The normal color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element is essentially neutral, not related to [source](#), [target](#) or [output](#) signal. This color is expected to contrast against the [source color](#), [target color](#), and [output color](#) to some degree.

2.3.4. Target color

The target color parameters control the red, green, and blue components of the [target](#) color.

The target color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element relates to the [target](#) signal in some way. This color is expected to contrast against the [normal color](#) to some extent.

2.3.5. Output color

The output color parameters control the red, green, and blue components of the [output](#) color.

The output color is used in a variety of contexts, from interactive widgets to visualization elements. This color signifies that an element relates to the [output](#) signal in some way. This color is expected to contrast against the [normal color](#) to some extent.

2.3.6. Textures

The textures configuration allows you to change the user interface textures.

The panel texture is used for the background of the user interface and has the [shader params](#) applied. The meter texture is used to fill the visualization effects. The background texture is used throughout the plug-in for shading.

These settings are stored with user scope, so you don't need to change them with every instance. Closing a texture will revert to the default internal texture.

Typically, the panel texture should be very dark and the meter texture should be very light.

2.4. Settings



The settings tab contains various additional parameters. These parameters are broken down between General and Latency parameters. Since Latency parameters impact [delay compensation](#), changes to these parameters are deferred until you click the Apply button. It is generally not advisable to automate the parameters in the Latency section.

2.4.1. BPM

The bpm option allows you to set the BPM used by tempo-relative parameters.

2.4.2. Host BPM

The host bpm option enables usage of the host's BPM for tempo-relative parameters. When disabled, the [bpm](#) parameter is used instead.

This parameter is not available (nor applicable) to the standalone application.

2.4.3. Velocity sensitive knobs

If enabled, this will turn on velocity-sensitive dragging, so that the faster the mouse moves, the bigger the movement to the knobs. This helps when making accurate small-scale adjustments.

This parameter is saved at user scope, so it will be remembered between sessions.

2.4.4. Load preset visuals

The load preset visuals option allows you to enable/disable the loading of visualization and [theme](#) settings when loading [presets](#). All other settings will still be loaded; this setting only has an impact on the visual appearance of the plug-in and does not impact the audio.

This parameter is saved at user scope, so it will be remembered between sessions.

2.4.5. UI Scaling

The UI scaling option allows you to set the scaling of the user interface. This is useful for high-DPI displays, where the default scaling may be too small to read comfortably.

This parameter is saved at user scope, so it will be remembered between sessions.

2.4.6. Axis Scaling

The axis scaling option allows you to set the scaling of the axis ticks, labels and text bubbles. This is useful for high-DPI displays, where the default scaling may be too small to read comfortably.

This parameter is saved at user scope, so it will be remembered between sessions.

2.4.7. Dark mode

The dark mode toggle enables/disables dark mode. When enabled, theme colors have their brightness inverted.

2.4.8. Blocksize

The block size parameter determines the time frequency of FFT filtering. Generally speaking, lower block sizes will give more accurate results. However, lower block sizes also require more CPU resources, so it is necessary to find a balance. You can squeeze improved quality and/or performance by tuning this setting based on your available CPU resources.

BPM units for block size are evaluated once at the time you press Apply.

2.4.9. Delay compensation

The delay compensation parameter determines whether or not the plug-in will report latency to the host. Delay compensation is used by hosts to keep audio synchronized across channels.

The delay compensation option is not available (nor applicable) to the standalone application.

2.5. Update

The update tab allows you to check for the latest product versions. Just click “Check for updates” to see the latest version numbers. If you’re not running the latest version, you can click “Download” to open the download page in your default browser.

2.6. About

The about tab contains basic information about the plug-in. This is also where you can activate or deactivate your product keys and check license status.

3. Standalone CLI

APU Spectrum Analyzer's standalone application exposes a small user-facing command-line interface for loading, saving, and resetting standalone preset files. This section documents the supported options only.

Supported options:

- `--help` prints the supported standalone CLI options and exits.
- `--resetParams` resets parameters after the standalone app loads its remembered state.
- `--loadPreset=<path>` loads a preset file before the window is shown.
- `--savePreset=<path>` writes the resulting preset file and exits without opening the user interface.

Processing order:

- The standalone app first loads its normal remembered standalone state.
- If `--resetParams` is present, a full parameter reset is applied.
- If `--loadPreset` is present, that preset file is loaded next.
- If `--savePreset` is present, the resulting state is written to disk and the app exits immediately.

Examples:

- `<standalone-app> --help`
- `<standalone-app> --savePreset="C:\Temp\spectrum-startup.preset"`
- `<standalone-app> --resetParams --savePreset="C:\Temp\spectrum-reset.preset"`
- `<standalone-app> --loadPreset="/tmp/spectrum-session.preset"`
- `<standalone-app> --loadPreset="/tmp/spectrum-session.preset" --savePreset="/tmp/spectrum-copy.preset"`

Compatibility:

- `--loadPreset` and `--savePreset` use the same file format as the standalone app's standard JUCE options-button commands, `Save current state...` and `Load a saved state...`
- These file-based presets store the full standalone processor state. They are different from the in-app [presets](#) combo-box, which loads the product's built-in preset entries and user preset-list selections.

4. Glossary

This section defines some of the concepts used within the software.

4.1. Range sliders

Range sliders are used throughout the plug-in in order to specify the upper and lower boundaries of a range. These ranges can be controlled via mouse in various ways.

- Click and drag the lower thumb to adjust the minimum value.
- Click and drag the upper thumb to adjust the maximum value.
- Click and drag the region between slider thumbs to move both values. This allows you to adjust the average loudness without expanding/contracting the dynamic range.
- `Ctrl` + click and drag the region between slider thumbs to expand/contract range without changing the average (center) value. Drag the mouse up and down, left and right are ignored.
- `Shift` + click and drag the region between slider thumbs to combine both. Drag the mouse up and down to expand/contract range. Drag the mouse left and right to move both values.

4.2. Histogram

One of the primary views into your audio that this software provides is a real-time histogram. Histograms in general provide a quick and intuitive way to understand the relative frequency of different measurements. This is very useful when judging the overall dynamic range of the audio. The histogram provided by this software is capable of changing [history length](#), [bucket size](#) and size continuously.

4.3. Source

The term “source” is used throughout the plug-in to identify the plug-in’s input source signal. This signal is represented in the user interface by the current theme’s [source color](#).

4.4. Target

The term “target” is used throughout the plug-in to identify the configured target range loudness. This signal is represented in the user interface by the current theme’s [target color](#).

4.5. Output

The term “output” is used throughout the plug-in to identify the [output type](#) signal. This signal is represented in the user interface by the current theme’s [output color](#).

5. Credits

This software was developed by [APU Software, LLC](#) and is available as VST (windows x64/x86, macOS universal), Audio Unit (macOS universal), Pro Tools AAX (windows x64, macOS universal), or Standalone Application (windows x64/x86, macOS universal). The software libraries below are utilized for portions of the software:

- [JUCE](#) (cross-platform audio and user interface framework)
- [Boost](#) (header-only algorithms)
- [melatonin_blur](#) (blur effects)
- [PFFFT](#) (FFT library)

Demo video song credits:

- Annasara - A Lifetime Rolls By, licensed via [Audiio](#)



5.1. MIT License (libebur128)

Copyright (c) 2011 Jan Kokemüller

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the “Software”), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED “AS IS”, WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

5.2. MIT License (melatonin_blur)

Copyright (c) 2023 Sudara Williams

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

5.3. FFTPACK License (pffft)

Copyright (c) 2013 Julien Pommier (pommier@modartt.com) Based on original fortran 77 code from FFTPACKv4 from NETLIB, authored by Dr Paul Swarztrauber of NCAR, in 1985. As confirmed by the NCAR fftpack software curators, the following FFTPACKv5 license applies to FFTPACKv4 sources. My changes are released under the same terms. FFTPACK license: <http://www.cisl.ucar.edu/css/software/fftpack5/ftpk.html> Copyright (c) 2004 the University Corporation for Atmospheric Research ("UCAR"). All rights reserved. Developed by NCAR's Computational and Information Systems Laboratory, UCAR, www.cisl.ucar.edu. Redistribution and use of the Software in source and binary forms, with or without modification, is permitted provided that the following conditions are met:

- Neither the names of NCAR's Computational and Information Systems Laboratory, the University Corporation for Atmospheric Research, nor the names of its sponsors or contributors may be used to endorse or promote products derived from this Software without specific prior written permission.
- Redistributions of source code must retain the above copyright notices, this list of conditions, and the disclaimer below.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions, and the disclaimer below in the documentation and/or other materials provided with the distribution. THIS SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE CONTRIBUTORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS WITH THE SOFTWARE.