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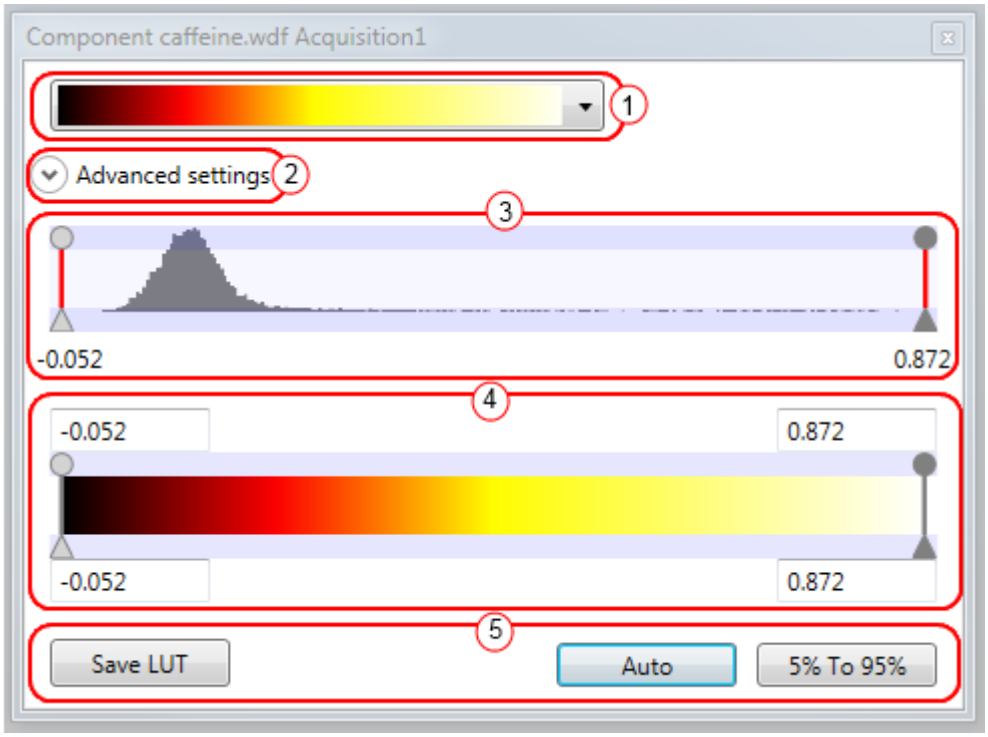
TM034 - WiRE Look-Up Table control WiRE™ 5

This document aims to show the WiRE™ 5 user how to use the Look-up-table (LUT) control for optimising the display of images and data.

The control extends older versions (WiRE 4.3 and before) by allowing user-defined colour tables, and by offering far richer control over transparency. Adding further versatility, the user defined colour tables can be saved either as a global colour table for all users on the PC, or saved just for use with the current file on the current PC.

LUT concepts

Quite simply, the LUT control allows the translation of WiRE image data (ranging from dataMin to dataMax) into a 256 colour colour table.
Due to the wide range of data that is supported in WiRE, and the necessity to prevent data outliers from de-sensitising the control, WiRE uses two sets of horizontal sliders to define the data range used.



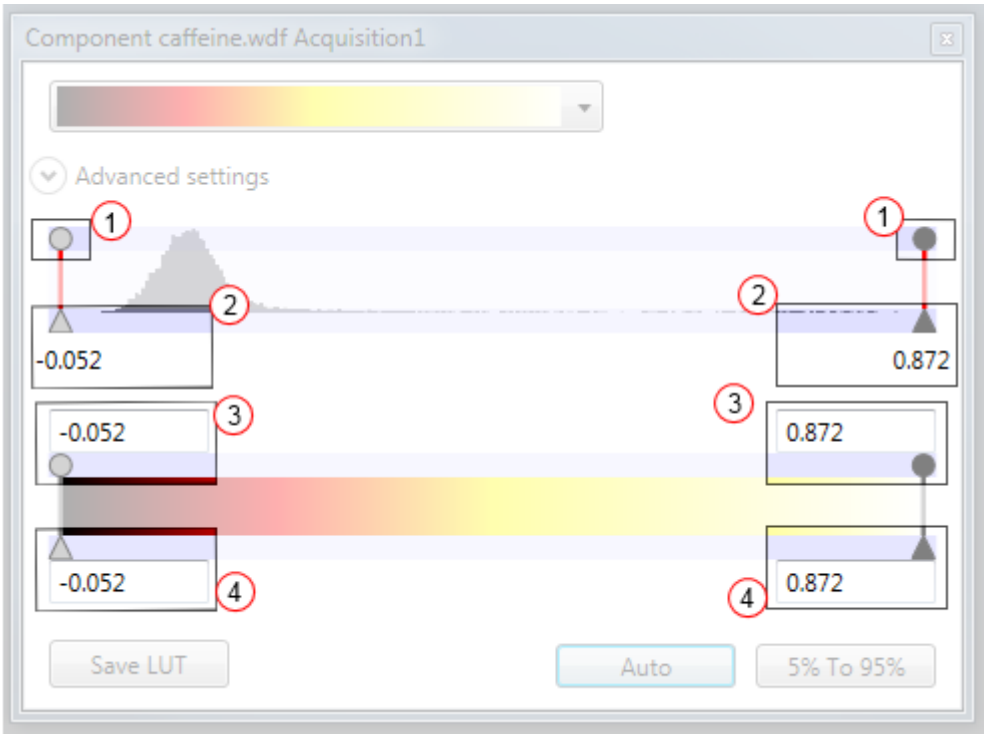
The controls above are as follows:

1) The LUT colour map selector.
2) Advanced Settings allows the user to customise / edit / define colour tables
3) The zoom view covers the full extent of the data, and gives the user control over which section of their data should be mapping to the colour table. The height of the histogram plot shows the number of data values at that point, giving the user a guide as to where best to set their range.
4) The LUT data range control allows the user fine control over mapping the data to the colour table. The full width of this control maps to the numerical range defined by the data sliders in the zoom view.

5) The buttons
   a) Save LUT is used when the user has modified a colour table using the Advanced settings and wishes to save it. The slider positions for both transparency and data are automatically saved whenever they are moved and are not related to this button.
   b) Auto resets all the sliders to their full range, so that the data range control and the zoom control show the same range.
   c) 5% to 95% sets the data sliders in the data range control to cover 95% of the data values covered by the full range of the data range control.

Data sliders and transparency sliders

Various controls are made available to the user to give them full control over the image created from the data.



These controls (marked 1 to 4 in the image above) are all draggable along their ranges. The circles denote transparency upper and lower values; triangles denote data values.

1) The upper and lower transparency values (coarse scale).
2) The data zoom sliders that are used to set the full-width range of the data range control below it. This range is used to clip out outlying data points.
3) The transparency sliders. These are only available when the sliders (1) are dragged level with the data zoom markers (2).
4) The data range sliders. These give the fine control of the actual upper and lower data values that will be mapped through the LUT to generate the image.

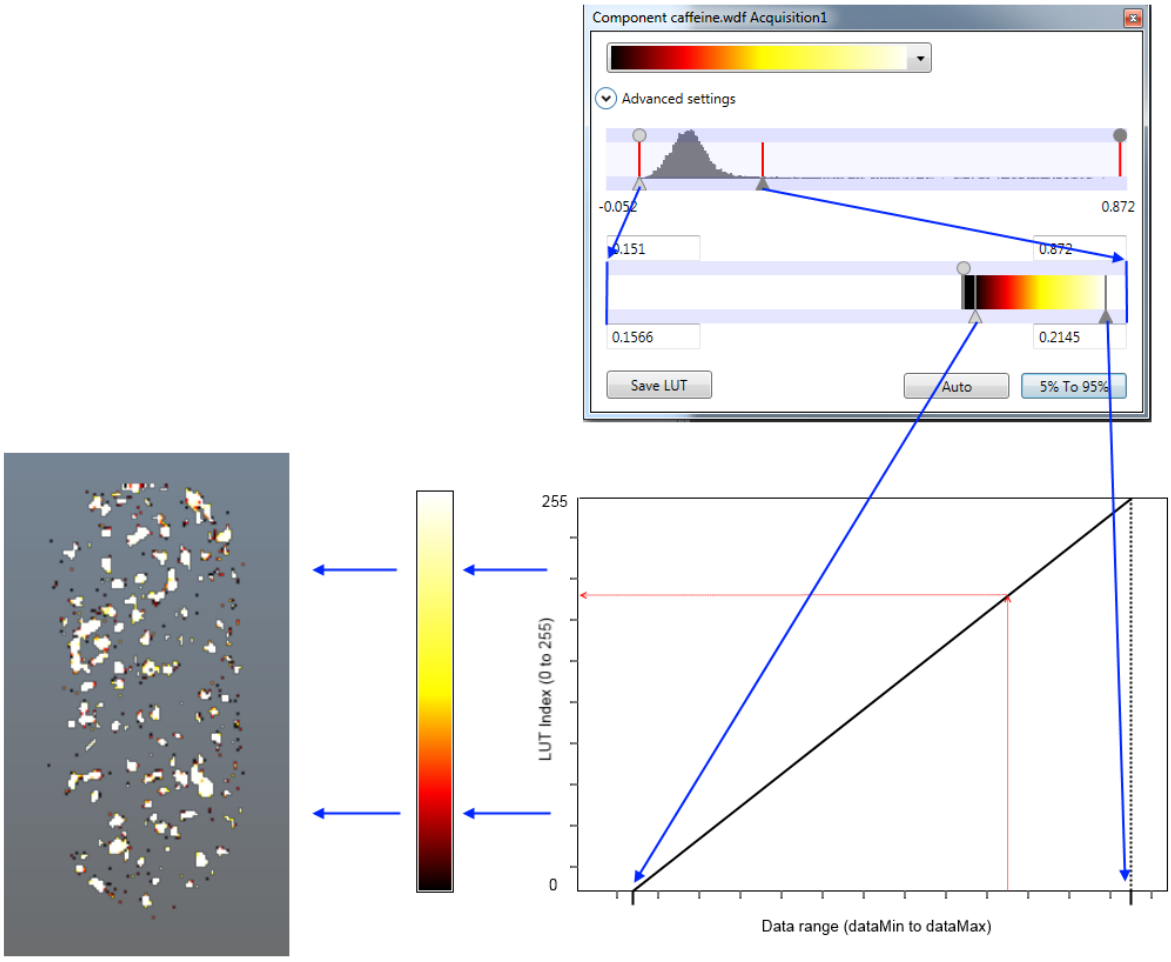
The reason there are two controls (the zoom control and the data range control) is to work around the scenario where outlying data points result in the bulk of the histogram covering a width of only a few pixels, thereby making the step size for the data sliders very coarse. Using the 2-control methodology shown above, the data zoom makers (2) could be only a couple of pixels apart, but the user will still have fine resolution on the data range by using the sliders (4) in the in data range control.

From data value to false colour

The mapping is done in 4 stages

Raw data -> reduced data range -> 0-255 -> LUT

The control of this process through the LUT control is depicted in the below image.



Here, the full range is shown in the top half of the LUT control. The data zoom sliders have been moved to contain the bulk of the image data as shown by the histogram. This range is then used as the full width of the lower control, where finer control has been use to set the positions of the dataMin and dataMax sliders.
The dataMin and dataMax values are then mapped linearly through the range 0 to 255 to allow the indexing of the LUT.

Using transparency

Unlike the data sliders, the transparency sliders in the zoom control do not ‘zoom’ the range of the sliders in the data zoom control. The transparency sliders operate initially in the Zoom view on the full range of the data.

If a transparency slider is dragged so it is level with a data slider in the Zoom view, then it will block at this position (it is not possible to drag the transparency slider past the data slider) and control is then delegated to a second transparency slider that will appear in the data range control (the lower control).
Therefore, the rules for use of the transparency sliders are as follows:

- If a transparency slider is visible in the data range control then the transparency value will be taken from this slider.
- If a transparency slider is not visible in the lower control then the transparency value will be taken from the corresponding slider in the Zoom view.

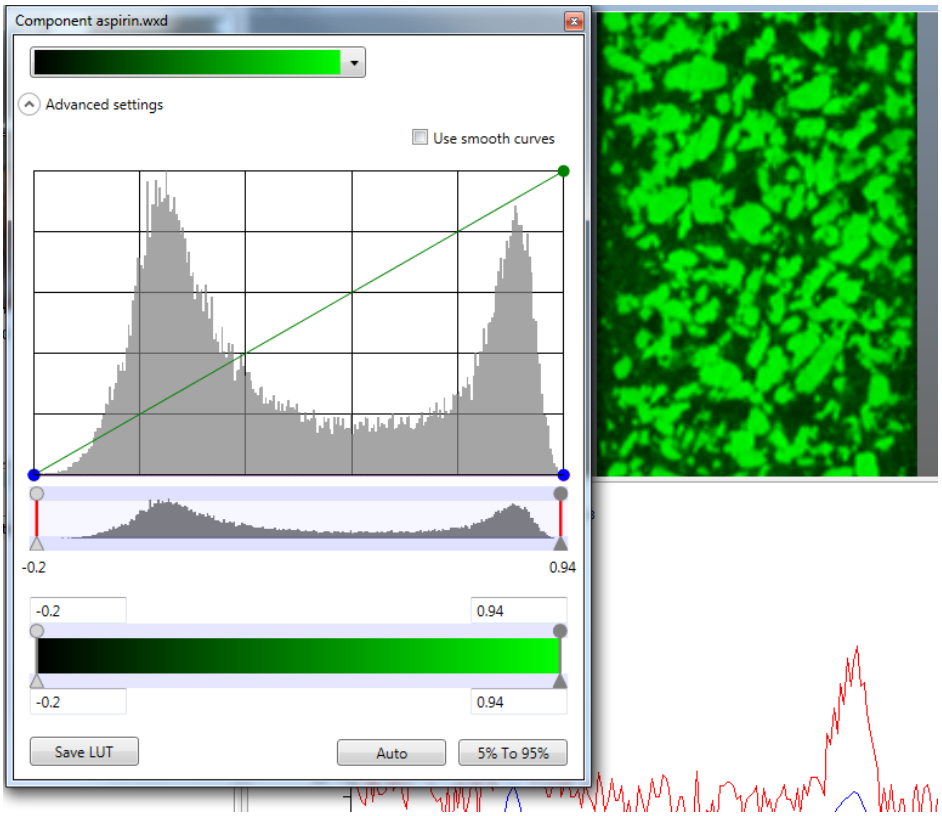
To make the whole image fully visible, then the transparency sliders in the upper control, the data zoom control, must be dragged out to the extremes.

Colour tables

Colour tables can be customised, either for general use or for specific use just with one file.

A colour table maps the LUT index (in the range 0 to 255) to a RGB colour. A colour table is effectively 3 lists of values (one each for Red, Blue, and Green), with each list holding 256 elements.
A set of default LUTs exist (Grey, Red, Green, Blue, Fire, Ice, Earth, Cyan, Magenta, Yellow, Prism, Rainbow, Steps).

To customise a colour table, the user needs to click on the Advanced Settings button on the LUT control. This will reveal a graph showing the mapping of the RGB channels to the LUT index.

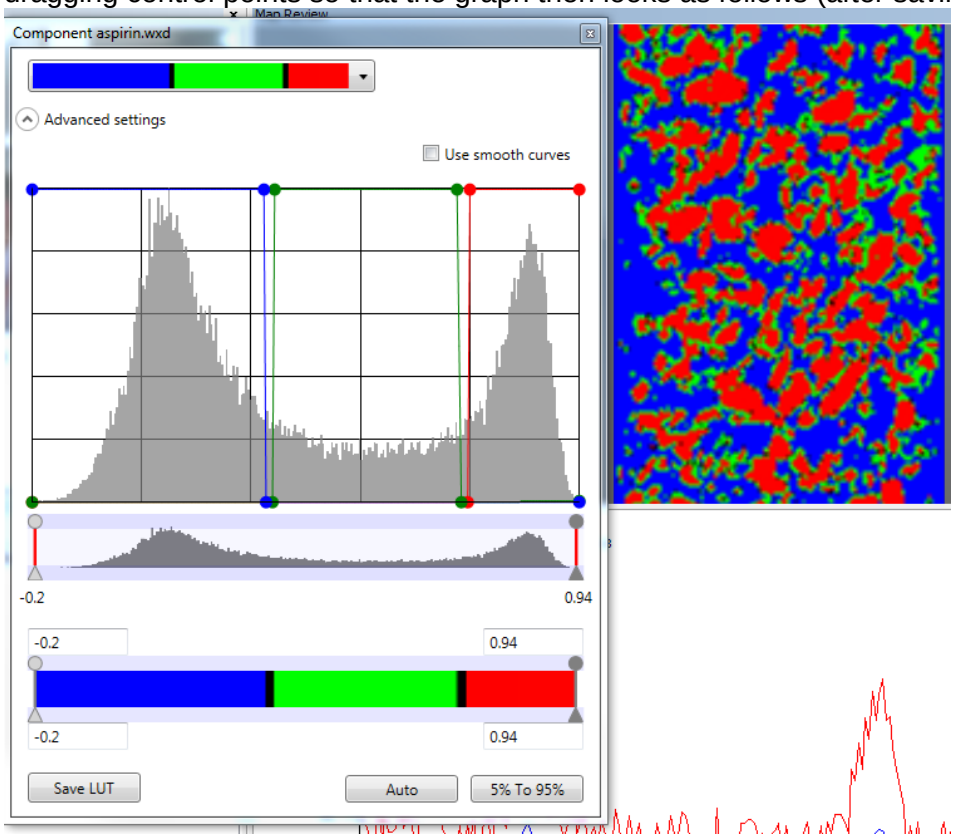


A histogram is shown as the background to the graph. The histogram range directly maps to the range defined by the data sliders (draggable triangles) in the data range control (the bottom control in the window). This enables the user to manually set the colour table to most enhance their data.

The RGB lines in the histogram are configured by control points. For example, the most basic linear histogram for Red that would map LUTIndex 0 to Red value 0 (ie black) and LUT index 255 to Red value 255 would have 2 control points, one at the bottom left of the graph and one at the top right. In the example shown above for a green LUT, the control points for both blue and red channels are from 0,0 and 255,0, whereas the green control points are at 0,0 and 255, dataMax.

Control points can be added by placing the mouse over the XY position where the control point is required, then left clicking the mouse whilst holding down shift.
Control points can be deleted by placing the mouse over the point to be removed and left clicking the mouse whilst holding down ctrl. The control points at the start and end of each colour line cannot be deleted.
Tooltips appear when the mouse is hovered over the LUT graph to remind the user of this functionality.
If control points from the other colours overlay the colour being edited, then either temporarily drag them out of the way, or they can be hidden from the view by r-clicking and ensuring that only the colour being edited has a tick.

A customised colour table can be generated that will show all the pixels in the left hand curve in blue, in the central dip in green, and in the right hand hill in red by adding and dragging control points so that the graph then looks as follows (after saving it – see below):

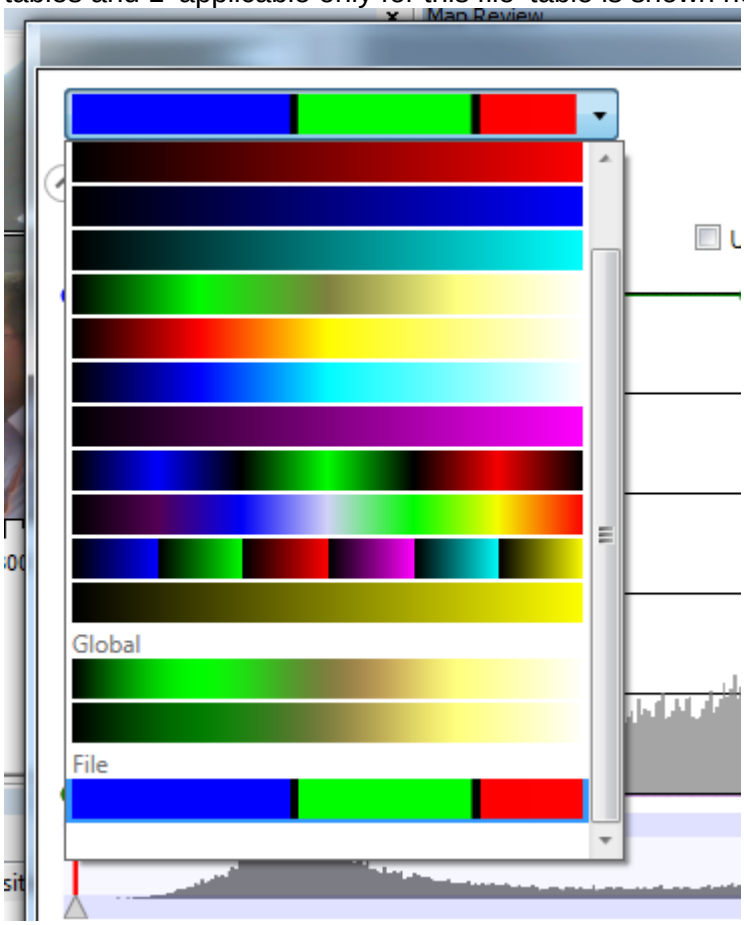


Once a user has got their colour table exactly as required, then it can be saved using the **Save LUT** button. The user is presented with a choice of two save modes

File : The colour table will be only available for this file. It is not however saved in the file so if the file is moved to a different PC then the colour table will not be available on that new PC.

Global : The colour table will be available to all files on this PC.

An example of the colour table selection drop-down showing 2 Global user defined colour tables and 1 'applicable only for this file' table is shown here:



Note it is recommended that the user does not overwrite the default colour tables; although this can be recovered by the r-click->FactoryReset option.

Should a user wish to manually construct one or more customised colour tables, the file format is ascii and easy to generate. It simply consists of the set of control points per RGB channel, and a flag to indicate that the connection between the points is a straight line ("linear") or a curve ("spline"). The existing colour tables can be inspected using any text editor to determine the exact format.