Display Tools: Program rgb_cmy_plot

CORENDERING THREE ATTRIBUTES AGAINST RED-GREEN-BLUE OR CYAN-MAGENTA-YELLOW – Program rgb_cmy_plot

Program rgb_cmy_plot has two modes. In the first RGB (additive red-green-blue color) mode, it plots one attribute against red, a second against green, and a third against blue. If all three colors are saturated, one obtains white. In the CMY (subtractive cyan-magenta-yellow color) mode, it plots one attribute against cyan, a second against magenta, and a third against yellow. If all three colors are saturated, one obtains black.

Flow Chart

The input to program rgb_cmy_plot provides a means to map three attributes against either an RGB or CMY color model. In either model, to avoid saturation by a single component (and thus color) care needs to be taken such that the individual attributes span their entire dynamic range. In general, unipolar (either all positive or all negative) attributes display best. The most common use of the RGB model is to display multiple spectral components. The most common use of the CMY model is to co-render multiple edge detectors.

Running rgb_cmy_plot
Display Tools: Program rgb_cmy_plot

Program rgb_cmy_plot is located under the Display Tools tab -> rgb_cmy_plot of the main aaspi_util GUI:

![GUI screenshot](image)

The following GUI appears:
Plotting spectral components against the RGB color model

To begin I chose three input attributes which are the 14, 34, and 54 Hz spectral components generated by the program `spec_cmp` for the Boonsville data volume which are shown below:
Display Tools: Program *rgb_cmy_plot*

**CMP Spectral Magnitude Component at 14.00 cycles/s**

*Time* = 1.14 (Panel = 58)

**CMP Spectral Magnitude Component at 34.00 cycles/s**

*Time* = 1.14 (Panel = 58)
(1) I chose the `spec_mag_3d_cmp_boonsville_0_14.00.H` attribute to be plotted against the red axis. (2) I chose the `spec_mag_3d_cmp_boonsville_0_34.00.H` attribute to be plotted against the green axis and lastly (3) I chose the `spec_mag_3d_cmp_boonsville_0_54.00.H` attribute to be plotted against the blue axis. Most interpretation workstations only allow the importation of 256 colors as of September 2009. Therefore leave the color size as the default (4). Then select (5) to execute. The following 3D histogram appears:
The following 3D color bar appears:
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Finally, the final image appears as:

Because of the 8-bit color limitation, the image is less than satisfactory. Therefore I plotted 256 colors for each of the axes (red, green, and blue). The GUI should look something like this.
A 3D histogram appears shown below are different slices:
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3D histogram

CMP_Spectral_Magnitude_Component at 54.00 cycles/s=0 (Panel=1)

3D histogram

CMP_Spectral_Magnitude_Component at 54.00 cycles/s=0.110588 (Panel=48)
Next, a 3D color bar appears and a video through the different slices is shown below, double click to view video:

![RGB_16777216_colors.mp4](rgb_cmy_plot)

Lastly, the final image looked like
The above image with 16,777,271 colors is much smoother compared to the unsatisfactory image using only 256 colors. The karst collapse features are readily seen and the edges are highlighted in black.

**Plotting spectral components against the CMY color model**

To change from the RGB to the CMY color model, (1) click the tab that defines the color model. The GUI should look something like this:
Again, I chose three input attributes which are the energy ratio similarity, dip magnitude, and the most positive curvature (k1) from the Parihaka New Zealand data volume which are shown below:
Display Tools: Program \texttt{rgb_cmy_plot}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig1.png}
\caption{Dip Magnitude}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig2.png}
\caption{Post-Positive Principal Curvature (k1)}
\end{figure}
These can be calculated from similarity, dip3D, and curvature. (2) I chose the energy_ratio_similarity_meters_1-2.H attribute to be plotted against the cyan axis. (3) I chose the dip_magnitude_meters_1-2_1-2.H attribute to be plotted against the magenta axis and lastly (4) I chose the k1_meters_long_w.H attribute to be plotted against the yellow axis. Most interpretation workstations only allow the importation of 256 colors as of September 2009. However, here I am able to display 256 colors along each axis so a total of 16,777,216 colors shown by block arrow (5). Then select (6) to execute. The following images for the 3D histogram, 3D color bar, and the final plot should appear:
Next a 3D color bar appears which is shown below in a video format, double click link to view video:

CMY_16777216_colors.mp4
The CMY color model is good for enhancing edge like features such as the listric fault that is indicated by the black arrow in the above image. With 256 colors displayed on each axis the image is smoother compared to an image with only 256 colors displayed total.
Theory

The initial development and deployment of color hardware in the geophysical industry began by a need to display seismic attributes on the same image as the wiggle traces (Guo, et al.). Color display has evolved significantly over the years the basic color models have remained the same. Cyan-magenta-yellow-black (CMYB) is used for printing and red-green-blue (RGB) is used for active screen display. RGB is an additive color model where red, green, and blue are light primaries that are mixed to produce other colors. While the CMY is a subtractive color model where cyan, magenta, and yellow are mixed to reproduce other colors which is the working model for printers. The CMY color model is constructed from the inversion of the RGB color model. Because of this relationship the CMY and RGB color models are complimentary of one another (Purves, et al., 2011). According the Purves et al. (2011), when CMY is used with structural attributes the subtractive color model produces images showing structural variations and faults represented by darker colors. The attributes can be combined using CMY to enhance edge features such as faults. When plotting three attributes using CMY where one attribute dominates so will the associated color. A high response in the three attributes results in a blend of the component colors which in the CMY color space is black. A high probability of faulting will result in dark colors (McArdle, et al, 2014). The RGB model has a greater range of human color perception compared to CMY. The RGB color model is a very good method for rendering three attributes with similar units and has a reasonable level of correlation. CMY color models are much better for visualizing structural data while RBG color models are much better for representing spectral components (Purves, et al., 2011).

References