

The IFRAO Color Scale: Some Considerations

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Since its introduction (Bednarik, 1994; Bednarik and Seshadri, 1995), the International Federation of Rock Art Organizations (IFRAO) color scale has been widely used by rock art researchers around the world. However, we are not aware of generally available software that permits accurate color correction of images that include the scale. Therefore, we have conducted a series of tests, trying to develop a method to use the scale for color correction. We are not fully satisfied with the methods evaluated, and propose that a redesign of the scale, along with software development, should be considered.

Test Procedures

Thirty-five mm slides of an IFRAO scale on top of a Macbeth ColorChecker Chart (Fig. 1), were scanned (using either Photo-CD or Nikon SuperCoolscan). The charts, themselves, were also scanned on a Sharp flatbed scanner. The IFRAO chart has saturated colors, whereas the Macbeth chart has both saturated and subdued colors, more typical of rock and rock art colors. The photographs were taken under several different lighting conditions:

- Sunlight
- Shade
- Photo copy lights (red cast)
- Fluorescent lights (green cast)

Color corrections were done using Adobe Photoshop and with Canon CLC Calibrator software on a Power Macintosh computer. Because satisfactory digital color information was not available for the Macbeth Chart (available calibrations differed greatly) we decided to use the photograph of both charts in full sunlight as our standard for calibration and comparison.

Adobe Photoshop was used to correct the charts based only on the white and black squares in the IFRAO chart. The Photoshop Levels command was used, selecting the white and black sample in the IFRAO scale using the appropriate eyedropper tools. The method is illustrated in figure. 2. Experiments with slides taken in actual field conditions suggests that the black square appears to be too light, and therefore the corrected image is too dark.

Canon CLC Calibrator software expects to use hundreds of colors to define a calibration. We had only the eight colors of the IFRAO chart for our calibrations.

For each image Photoshop was used to record the RGB (red, green, blue) and L,a,b (luminance (L) and two chromatic components: a ranges from green to red, and the b ranges from blue to yellow). of each IFRAO and Macbeth chart color. The CLC software was then run to correct each image (RGB values) using the sunlight-image IFRAO RGB values.

In both cases (Photoshop levels and CLC), numerical results (L,a,b values) were compared to the Macbeth and IFRAO values from the sunlight image. An average error value was calculated as:

$$E = \frac{\sqrt{(L)^2 + (a)^2 + (b)^2}}{n}$$

where

n = 24 for Macbeth

n = 8 for IFRAO

$$L = L - L_{\text{sun}}$$

$$a = a - a_{\text{sun}}$$

$$b = b - b_{\text{sun}}$$

Results

The E results, which approximate perceived color differences, are displayed in Figure 3 and Table 1, with a E of 1 just noticeable (Kang, H. R., 1997, p. 12). The Photoshop method produced variable reduction and increase in the error, although it did produce a noticeable reduction in both the red and green color cast. The CLC method produced the expected large error reduction for the IFRAO colors used for calibration (85%-91%), and a significant but smaller reduction in error of the Macbeth colors (30%-64%). The corrected charts are still visibly different from the sunlight 'standard' (Fig. 1; color image file available from the authors: rmark@infomagic.net).

Discussion

The CLC software is a "black box", but it is designed to use hundreds of colors for calibration, not the eight available on the IFRAO color scale. Other color correction software, such as the Kodak Input Profile Builder is also designed for color charts (such as IT8) with a large number of colors. In addition, the saturated colors on the IFRAO chart may be outside the color gamut (range) of typical scanners, adding additional errors to any correction process.

This is an interim report on work in progress, however the following suggestions are made:

1. Consideration should be given to redesigning the IFRAO color chart, with more gray levels, and with unsaturated colors within the gamut of most scanners, and more typical of rock/rock art colors.
2. New color correction software should be designed specifically for the color chart, and made available perhaps as a Photoshop plugin. It is possible that existing color correction software could be modified for this purpose. We are currently investigating histogram-matching software.

A false sense of security may be generating using color scales that may not, in fact, permit easy, optimal color correction. More investigation is required, and appropriate correction software needs to be distributed.

Acknowledgments

We thank Robert Bednarik for his leadership in alerting the rock art research community to the color-correction problem and freely distributing the first version of a color chart. Canon Systems Management Europe Ltd made the CLC Calibration Software available for this work. We received helpful advice from Gregory J. Ward of Lawrence Berkeley National Laboratory, California.

Any use of trade, product, or firm names is for descriptive purposes only, and does not imply endorsement by the U.S. Government.

References

Bednarik, R. G., 1994, Introduction of the IFRAO Standard Scale, *Rock Art Research*, V 11, No. 1, pp. 74-75.

Bednarik, R. G., and K. Seshadri, 1995, Digital Colour Re-constitution in Rock Art Photography, *Rock Art Research*, V 12, No. 1, pp. 42-51.

Kang, H. K., 1997, *Color Technology for Electronic Imaging Devices*: SPIE Optical Engineering Press, Bellingham, Washington, 369 pp.

Captions

Figure 1. Matrix of images: Columns are image sources, rows are correction procedures. Color image file available from the authors (rmark@infomagic.net).

Figure 2. Levels dialog box from Adobe Photoshop. Method: click with eyedropper tools on color chart image as indicated.

Figure 3. Plots of E values, for Macbeth and IFRAO charts, as a function of correction method. Sunlight images are used as reference standards.

Table 1. E values and % reductions, for Macbeth and IFRAO charts, as a function of correction method. Sunlight images are used as reference standards.

Sunlight



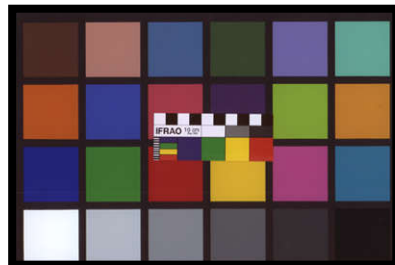
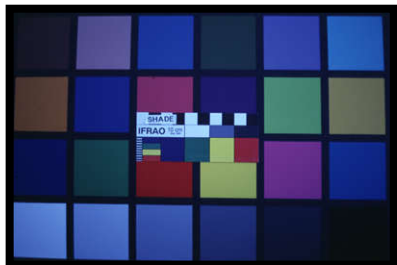
Shade

Fluorescent

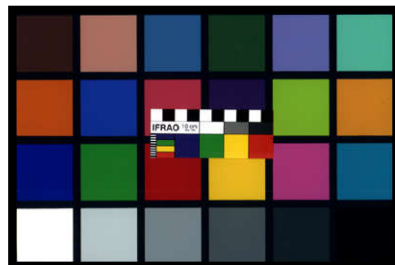
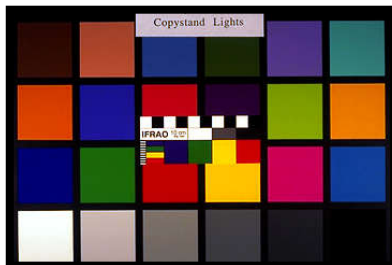
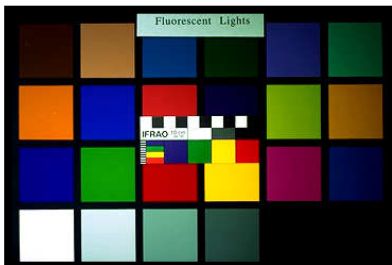
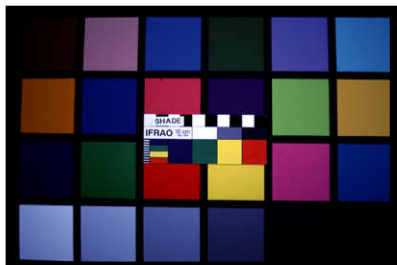
Incandescent

Scanner

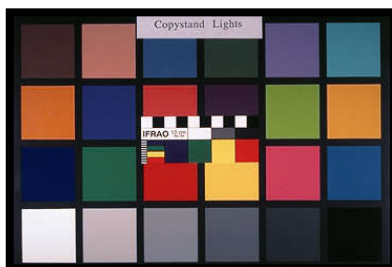
As Scanned



Photoshop B/W



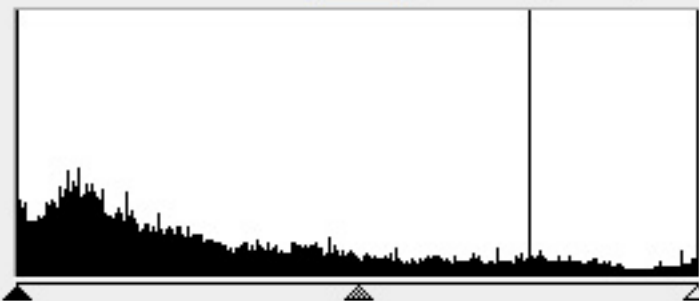
CLC/Sunlight



Levels

Channel: **RGB** ▼

Input Levels: **0** 1.00 255



Output Levels: **0** 255



OK

Cancel

Load...

Save...

Auto

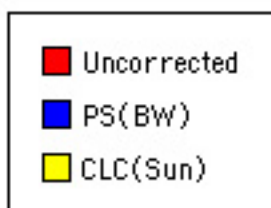
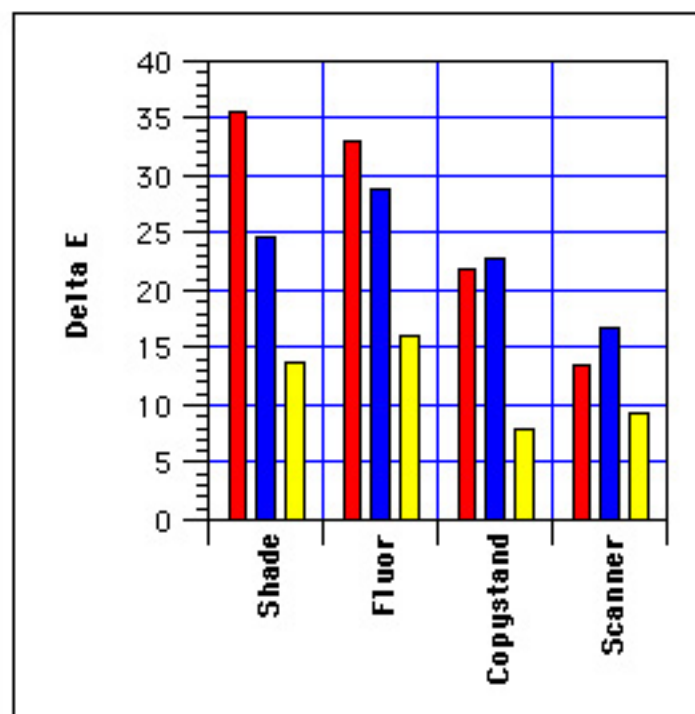


Preview

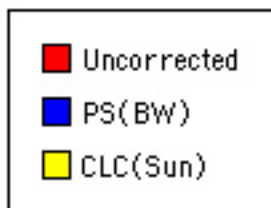
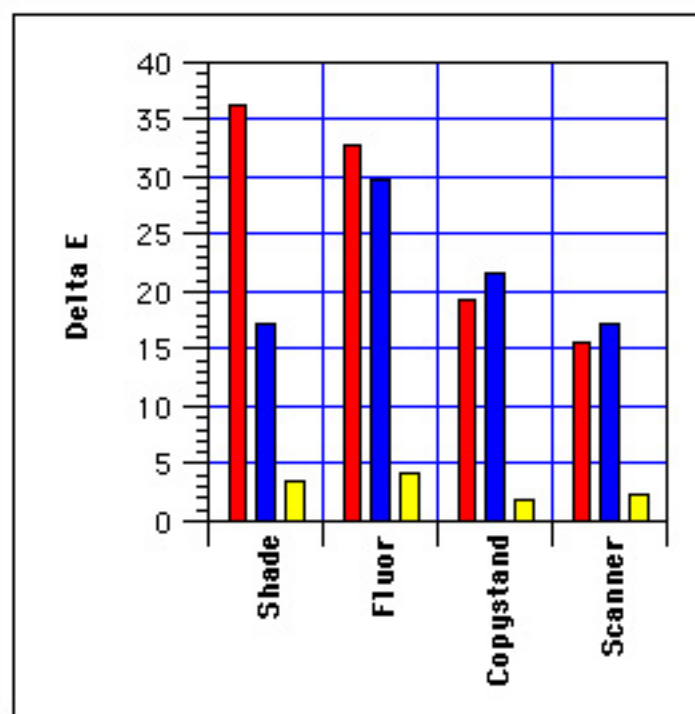
CLICK ON BLACK
SQUARE IN SCALE

CLICK ON WHITE
SQUARE IN SCALE

Macbeth



IFRAO



		Delta E Values			
Macbeth	Shade	Fluor	Copystand	Scanner	
Uncorrected	36	33	22	13	
PS(BW)	25	29	23	17	
CLC(Sun)	14	16	8	9	
IFRAO	Shade	Fluor	Copystand	Scanner	
Uncorrected	36	33	19	16	
PS(BW)	17	30	22	17	
CLC(Sun)	3	4	2	2	
		Error Reduction			
		%			
Macbeth	Shade	Fluor	Copystand	Scanner	AVG
Uncorrected	0	0	0	0	
PS(BW)	31	13	-5	-25	3.7
CLC(Sun)	62	52	64	30	51.9
IFRAO	Shade	Fluor	Copystand	Scanner	
Uncorrected	0	0	0	0	
PS(BW)	52	9	-11	-10	9.9
CLC(Sun)	91	87	90	85	88.3