Announcing a new workshop with Charles Poynton

Color for Digital Cinema: Origination, Mastering, and Display

Monday, June 14, 2004
Woodland Hills, Calif.

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CINE GEAR EXPO

Digital technology has recently become an alternative to film for the origination of motion pictures, for color grading (in the form of the digital intermediate), and for display in exhibition. Each of these developments is advancing independent of the others, leading to hybrid film-digital workflows. However, film and electronic media capture and reproduce images in fundamentally different ways. Film uses subtractive colorants (CMY), but digital cinema uses additive primaries (RGB). Film is characterized using logarithms, but digital video and computer graphics is characterized using power functions. Film and digital cinema have different color gamuts, and are optimized for different contrast ratios.

In this 1-day workshop, presented in cooperation with Cine Gear Expo, and to be held at the screening room at Panavision, Charles Poynton will detail the color science that underlies image reproduction in digital cinema. We explain how color is captured, encoded, and reproduced in video, computer graphics, and film. We discuss practical details of maintaining color quality through the imaging pipeline. Participants gain an understanding of the factors that need to be addressed to achieve accurate color, and learn pragmatic techniques that can be used to successfully implement digital cinema.

See the reverse of this flyer for a Syllabus and a Pop Quiz.

Who Should Attend:

- Cinematographers
- Assistant cinematographers
- Colorists
- Senior technical staff of studios and film labs
- Digital Imaging Technicians
- Digital cinema product developers

Charles Poynton is an independent contractor specializing in the physics, mathematics, and engineering of digital color imaging systems, including digital video, HDTV, and digital cinema (D-cinema). He is the author of *Digital Video and HDTV Algorithms and Interfaces,* and a Fellow of the Society of Motion Picture and Television Engineers (SMPTE). In 1994 he was awarded the Society's David Sarnoff Gold Medal for his work to integrate video technology with computing and communications.

Registration: Fee, $300. Enrollment is limited; advance registration is required. Some discounted registrations are available; check the ETC website for details. To enroll online: www.etcenter.org.

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Syllabus

Fundamentals: Radiometry; photometry; lightness terminology; contrast ratio.
Tone reproduction: lightness sensitivity; density; gamma in film, video, and CG.
Color reproduction: Classical CIE colorimetry; additive and subtractive reproduction; FCC/NTSC and Rec. 709 gamuts; necessity of matrixing; limitations of classical color science; shortcomings of CIE LAB and CIE LUV.
Film: Sensitometry (*D*-log *E* curves); film gamma; emulsion and dye spectral characteristics; printing density; gamut limitations; classical film workflow.
Image coding alternatives: constant luminance coding; perceptual uniformity and codeword utilization issues; implications for subsampling; *XYZ, LAB*, linear *RGB,* nonlinear *R'G'B', Y'*C_BC_R, log *RGB*, Cineon CPD/DPX.
Color appearance: Subjective effects; chromatic adaptation (and models); historical approaches to rendering in film and video; introduction to color appearance models.
Color management theory and practice: Color transform techniques; ICC architecture; device characterization and calibration; building and using ICC profiles.

The knowledge that you will gain by taking this course will enable you to answer questions such as these:

A0 Does pure Rec. 709 green have a longer or shorter dominant wavelength than pure FCC/NTSC green?
A1 Which encompasses more saturated magenta colors, cinema print film or Rec. 709 HDTV?
A2 Which Rec. 709 primary has [*x, y*] chromaticity coordinates of [0.3, 0.6]?
A3 What's the approximate wavelength of the unique red hue?
A4 If a small yellow disc at 5 cd·m^{-2} is projected on a dark screen then surrounded with 40 cd·m^{-2} of white light, does the color of the disc change? If so, to what?
A5 How many of the Macbeth ColorChecker's 24 patches are in-gamut for HDTV?
A6 Shooting sailboats on a sunny day, would you increase or decrease an HDW-F950 camera's default KNEE POINT from its factory setting?
A7 What's the approximate HDTV luma level of a Kodak mid-gray test card?
A8 In a 3CCD camera, is a linear matrix required to accurately reproduce colors?
A9 Does a deep red color on release print film have Status M cyan density value smaller or larger than its cyan SMPTE RP 180 printing density?

If you score better than 80%, you are welcome to attend to refresh your knowledge, or to learn the other 20%!

To make the most of this course, you should have a background that enables you to correctly answer at least half of these questions (closed book, calculator allowed, 3 minutes):

B0 What percentage of SDTV luma is contributed by green?
B1 What's the typical peak luminance of a consumer television receiver?
B2 What's the numerical value of the sine of 30°?
B3 Which of these are units of luminance: joule, cd·m^{-2}, nit, lumen?
B4 In 8-bit *Y'*C_BC_R, how many levels represent the reference black-to-white range?
B5 Which CIE Illuminant has chromaticity coordinates [⅓, ⅓]?
B6 What red, green, and blue values in Photoshop represent peak white?
B7 At *f*/16, using ASA 200 film, what shutter speed is appropriate to shoot an outdoor scene at noon on a bright, sunny day?
B8 What's the logarithm, to base 10, of 0.1?
B9 What color of dye is formed from the blue-sensitive emulsion of color film?

Answers: **A0** Longer **A1** Cinema print film **A2** Green **A3** Between 600 and 620 nm **A4** Yes, to brown **A5** 23 **A6** Decrease **A7** 0.434, or 43.4% (answers between 0.4 and 0.5 are acceptable) **A8** Yes **A9** Smaller **B0** 58.7 **B1** 200 cd·m^{-2} **B2** 0.5 **B3** cd·m^{-2}, nit **B4** 220 **B5** Illuminant E **B6** 255, 255, 255 **B7** $\frac{1}{200}$ s **B8** –1 **B9** Yellow