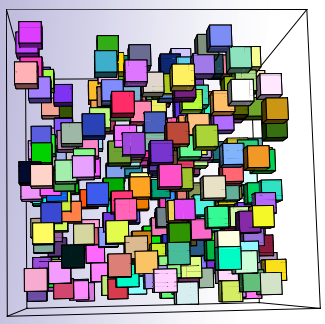
A workshop with Charles Poynton

Linear, log RGB, log neg, and Cineon printing density: What's in your DPX file?



Sydney, Thu. Jan. 19, 2012
fxphd/Future Reality/Deluxe
706 Mowbray Rd, Unit 2
Lane Cove NSW 2066 (Sydney)

This seminar was presented in Burbank in Feb. 2010, organized by VTP Corp. and presented at Dolby Labs. Previous presentations took place in Toronto and Vancouver.

DI houses and VFX houses are faced with a proliferation of acquisition formats including log RGB ("quasilog," such as Panalog, SI-log, REDLOG, and S-log), log neg (Cineon Printing Density), and "BT.709" in various forms (HyperGamma, Cine Gamma etc.). In addition, DI houses and VFX houses are presented with many formats described by DITs as "linear" but for which an 18% grey card does not approximate a signal code of 18 on a scale of 0 to 100! Any of these formats can appear in DPX files, but such files rarely contain sufficient metadata to identify the colour encoding.

In this 1-day workshop, organized by fxphd/Future Reality and hosted in Lane Cove, Charles Poynton will introduce the perceptual and mathematical properties of linear-light, power function, and logarithmic encodings. He will detail the parameters of these coding schemes:

- Power function (gamma) encoded BT.709/BT.1886, sRGB, CineGamma, "FILM REC," and HyperGamma, discussion of KNEE and SLOPE controls;
- Log *RGB* (quasilog) encodings: FilmStream ($\log_{60}$), SI-log ($\log_{90}$), Panalog, Sony-log (S-log), REDLOG;
- Log neg encodings: Cineon printing density (CPD/DPX), ARRI log C.

We will describe the trade-offs involved in choosing encodings suitable for D-cinema and HD projects; we'll review the bit depth requirements for digital imagery represented in various forms. We'll detail the 1D and 3D LUTs by which encodings are converted. We'll explain the origins of gamma values 1.0, 1.7, 1.8, 2.0, 2.2, 2.4, 2.6, 2.8, and 3, and explain where each is potentially appropriate at various stages of the DI pipeline. See overleaf for a detailed Syllabus.

Who Should Attend: The attendee should be very familiar with digital cinema acquisition, and should be quite comfortable with mathematics, including equations such as $y = m\,x + b$ and $T = 10^{-b}\,E^{-m}$. The workshop will be suitable for people in positions such as these:

- Visual effects supervisors, VFX/post-production/DI engineers
- CGI/VFX and digital cinema software developers
- Advanced-level Digital Imaging Technicians (DITs)
- Film scanner, film recorder, and colour grading system engineers

Registration: AUD 200. Detailed handout notes – some of which form portions of Mr. Poynton's forthcoming book – will be provided. Lunch and refreshments will be provided. For information, e-mail info@future.com.au, or telephone +61 2 9925 4355.

Charles Poynton specializes in the physics, mathematics, and engineering of digital colour imaging systems, including HD and digital cinema (D-cinema). He is the author of *Digital Video and HD Algorithms and Interfaces,* and is a Fellow of both the Society of Motion Picture and Television Engineers (SMPTE) and the BKSTS. Twenty years ago, he chose the number 1080 (as in 1920×1080) for HD and digital cinema standards.

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Introduction: Two views of imaging – the engineering view and the creative view; picture rendering and image state; establishing and preserving creative intent. Logarithms, exponentials, and power functions; the zone system; introduction to radiometry and photometry – lumens, lux, candelas, and $cd \cdot m^{-2}$ ["nit," nt].

Visual perception: Perceptual uniformity; lightness terminology; contrast ratio and its measurement(s); Lightness (CIE *L**), colour appearance effects (particularly Hunt's Effect and Stevens Effect), viewing conditions; picture rendering and image state; colorimetric matching and appearance matching.

Linear-light encoding: Additive reproduction; *XYZ, RGB,* and *LMS* tristimulus values; CIE [*x, y*] chromaticity; gamut limitations; bit depths; code efficiency and its visual impact; OpenEXR; colour implications of "raw" workflows.

"Gamma" (power-law, "DIT-linear") encoding: OECF and EOCF; studio reference displays (CRTs and emergent LCDs); emergent display standards; power function (BT.709) encoding and its variants (HyperGamma, FILM REC, Cine Gamma); gamma 1.0, 1.7, 1.8, 2.0, 2.2, 2.4, 2.6, 2.8, and 3 in video, HDTV, CGI, and film, 1-D LUTs; DCI $RGB^{1/2.6}$ and $XYZ^{1/2.6}$ encoding; studio-swing ("normal") and full-swing (extended/extreme); sRGB, treatment of the "linear segment"; the problem with "legalization."

Log *RGB* (Quasilog) encoding: Dynamic range; where the noise lives – noise near black and noise rectification; steps-per-stop; highlight (specular) handling; FilmStream (log_{60}), SI-log (log_{90}), Panalog, Sony log (S-log), REDLOG; ADC units (ADUs) and digital code values (DCVs) per photographic stop in various coding systems.

Log neg (CPD) encoding: Sensitometry and film gamma (*D*-log *E* curves); optical density and Beer's Law; "Subtractive" reproduction, non-fixed primaries and unwanted absorptions; "Printer lights" in the negative and in the scene; Cineon printing density (CPD); ARRI log C; colour grading and approval; colour neutrality of the *R* = *G* = *B* axis and the Carlos aims; film-out considerations.

Camera characteristics: Saturation, dynamic range, exposure latitude, and ISO/EI ratings; noise; highlight handling; histograms and "exposing to the right" (ETTR); GAMMA, BLACK GAMMA, KNEE POINT, and KNEE SLOPE controls; on-set previsualization and look management; "look" files and ASC color decision lists (CDLs). Characteristics of real cameras: Sony F23/SRW-9000, ARRI Alexa, Panavision Genesis, Sony F35/F65, RED, Phantom HD & 65, Silicon Imaging SI-2K, and others.

The DI/post/CGI/VFX pipeline: DPX and Cineon files as containers; quasilog (log *RGB*); log-neg (CPD), and video/HD image data in DPX files; integration of CGI and visual effects; colour characterization and calibration; LUTs: 1-D and 3-D; "view" LUTs and "print" LUTs; introduction to ICC colour management and ICC profiles; DCI standards and the reference projector.