

## A Workshop with Charles Poynton & DFFB UP.GRADE

### ACES from Theory to Making IDTs

2-day Workshop  
DFFB, Potsdamer Platz, Berlin  
in cooperation with  
UP.GRADE

Thu./Fri. Oct. 29/30, 2015  
09:00 – 17:00 CET

**For nearly 20 years**, cinema production and post-production was based upon the conceptual model of film acquisition: Even if image data was digitally acquired, the typical Cineon/CPD coding incorporated the technical parameters of film; in particular, the S-shaped tone response and the colour crosstalk of film. The CPD scheme made CGI and VFX difficult.

Digital cinema cameras are now commonplace; however, image data encoding is diverse and nonstandard. Some cameras generate data roughly comparable to a film scan (e.g., ARRI log C); others generate data comparable to HD (BT.709/BT.1886), or are based upon HD video (Hypergamma). "Log" formats of various kinds (e.g., Sony log, Red log). DI houses and CGI/VFX facilities have to deal with image data in new forms.

The Academy of Motion Picture Arts and Sciences (AMPAS) has released ACES 1.0, which defines a pipeline to acquire and process "scene-linear" data – that is, image data closely coupled to scene exposure. Colour transforms imposed during the DI process create the desired "look" and systematically compensate for the viewing conditions of cinema. The ACES scheme is being deployed commercially.

**In this Workshop**, Charles Poynton will discuss the technical and visual requirements for acquisition and processing using the ACES scene-linear model. He will introduce the basic technical parameters of various camera encodings and describe their dynamic range and noise properties. He will describe the *input device transform* (IDT) by which image data from different cameras is transformed to a common colourspace (ACES). He will outline how "picture rendering" is imposed in the DI pipeline by the ACES *reference rendering transform* (RRT). He will describe ACES log coding (ACESlog, ACESproxy), the ACES colourspaces (AP0, AP1), and describe the four key colour transforms in ACES: IDT, LMT, RRT, and ODT. He will explain how the scene-linear model is applied to the DI pipeline, and how it aids CGI/VFX integration. He will describe various output device transforms to yield imagery suitable for D-cinema, HD, and other displays. There is a significant hands-on component to the workshop. If you wish, bring your own camera and/or your own computer: We will have lights and colour charts, and toward the end of the workshop you can use what you've learned to make an ACES IDT for your own camera. See overleaf for a detailed outline.

**Who Should Participate:** This Workshop will be suitable for people in positions such as these:

- Technically minded cinematographers and colourists;
- Post-production and visual effects supervisors and post/VFX/DI engineers;
- HD/UHD engineers and Digital Imaging Technicians (DITs);
- Digital cinema, digital video, and CGI/VFX software developers.

Participants should be familiar with digital video/HD/UHD, with digital cinema, and with the rudiments of acquisition and colour grading. Knowledge of mathematics isn't required, but will certainly be useful; many graphs and equations will be shown!

**Registration:** €450. Detailed handout notes – some of which form portions of the second edition of Mr. Poynton's book – will be provided. For further information, or to register, communicate with Charles Poynton in Toronto or Christiane Schweda in Berlin (contact data in the margin).

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## ACES FROM THEORY TO MAKING IDTS – OUTLINE

<b>Introduction to ACES</b>	The logarithmic nature of human visual perception – or is it a power function? The zone system, the importance of 18% grey. Contrast ratio (“dynamic range”). Colour appearance effects (Hunt, Stevens, Bartleson-Breneman), how they are issues in digital cinema and HD, and how they are addressed in ACES. The key ACES concept: Picture rendering. The primacy of the reference display (art and craft upstream, science downstream).
<b>Colour science</b>	Colour acquisition, the CIE XYZ/xyY system and its derivatives, colour display, additive primaries, nonphysical primaries. Colourspace transformations. Perceptual uniformity. Colour appearance models.
<b>ACES</b>	The two central ACES colourspaces (A0 and AP1); the two image states (ACES and OCES). The four ACES transforms: IDT, LMT, RRT, ODT. The two reference devices: RICD, RP. The two log formats, ACESproxy and ACEScc. ACEScg colourspace.
<b>DI and Colour grading</b>	The concept of working space. “Linear” mode (lift/gamma/gain) and “log” mode; CONTRAST and BRIGHTNESS reinterpreted.
<b>Cameras and input transforms</b>	Camera spectral sensitivities. White balance. The necessity of $3 \times 3$ matrix transform ( <i>colour formation matrix</i> , CFM). Power function coding, log coding, quasilog coding. Overview of IDTs; how an IDT is constructed.
<b>Displays and output transforms</b>	Digital cinema reference projector (DCI P3); HD colourspace (BT.709/BT.1886), UHD colourspace (BT.2020). How to acquire or build an ODT. Colour calibration.
<b>Emerging technology</b>	HDR acquisition. HDR displays; spatially modulated backlights. Tone mapping. OLED and laser displays.
<b>Making IDTs</b>	Greyscale and colour targets; determining the parameters of log coding; illumination; statistical properties of the scene; optimization and error minimization procedures implemented by spreadsheet and by dedicated code.

Questions & discussion

[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*, recently published in its second edition, and he is a Fellow of the Society of Motion Picture and Television Engineers (SMPTE). Twenty five years ago, he chose the number 1080 (as in 1920×1080) for HD and digital cinema standards, thereby establishing “square pixels” for HD and digital cinema. In 1998, he was responsible for introduction of the Adobe RGB (1998) colourspace.