Colour Science for Digital Cinematography

A 1-day workshop presented by Charles Poynton
Tue Sep 25, 2018, at HFF Munich

When cinema was acquired, graded, and exhibited on photographic film, a very small number of film manufacturers set the colour science. "System design" was the exclusive domain of the film manufacturers. Now, it is extremely rare to shoot, post, or exhibit a movie on film. There is a diversity of manufacturers at every stage in the digital pipeline. Manufacturers may or may not perform adequate system design among their own products, but in practice every production uses equipment from several manufacturers, and a large question arises: Who does the system design?

Cinematographers plan that the images launched into the production/post/grading/ mastering pipeline best serve the story told. The cinematographer should be the primary high-level system designer. But a rather new knowledge base is required: the colour science of digital cinematography.

In this 1-day workshop, Charles Poynton will introduce the fundamentals of colour science as applied to modern digital cinema cameras and production/post/DI processes. Major topics are these:

• We image based upon light, so discussion of digital cinematography must start with how light is measured and sensed: the science of radiometry and photometry. We'll link that science to exposure, sensitivity, LV, EV100, ISO, and EI.

• Photon ("shot") noise is the dominant source of noise in modern digital cameras; however, the topic is widely misunderstood and rarely discussed.

• Image coding systems used throughout the imaging chain are based upon perceptual uniformity. We'll discuss "just-noticeable differences" (JNDs), the Barten and PQ functions, and relate these concepts to various camera log coding functions.

• Camera colour spaces do not represent spectral sensitivities of film, and do not represent the spectral sensitivities of human vision. The mismatch leads to metamerism, where colours are distorted. The issue relates to colour gamut, and is intimately connected to the 3x3 matrices that are found in ACES IDTs. Metamerism is a particular concern with LED lighting; metamerism is also a potential problem for laser projectors and quantum dot displays.

• Appearance issues. Charles was very recently awarded a PhD for his research on tone and colour mapping done in cinema and HD/UHD/HDR. His key conclusions concern how colour appearance is maintained across diverse acquisition and display conditions. He will review his thesis research, and link his research to the ACES RRT, ACES ODTs, and on parametric appearance transforms (such as DRT).

In addition to being of interest to cinematographers that use real cameras, the workshop will also be of interest to the CGI/VFX community, who use virtual cameras. It is important in many CGI/VFX productions to produce images that look like they came from an actual camera, so all of the issues above are in play.