

# Colour management for Digital Acquisition

Cédric Lejeune, Workflowers

Autodesk



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## Cédric Lejeune

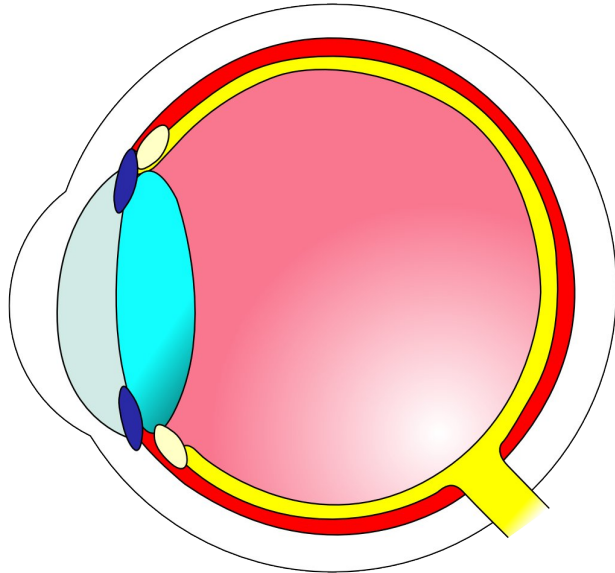
- From Lille, France
- Workflowers, services for postproduction
- Before, set one of the first DI setup in the world at Eclair Laboratoires, Paris
- Member of the CST ([www.cst.fr](http://www.cst.fr))
- Workflow and colour calibration for DI companies
- Now more and more interested in what happens before...

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# Vision



- Retina/iris
- Rods for brightness
- Cones for colours
- We are not equal (colour blindness, sensitivity...)
- The brain does a lot of work

# Colour Management?

« In digital imaging systems, color management is the controlled conversion between the color representations of various devices, such as image scanners, digital cameras, monitors, TV screens, film printers, computer printers, offset presses, and corresponding media. » *Wikipedia*



# Video shooting



Onset



Post



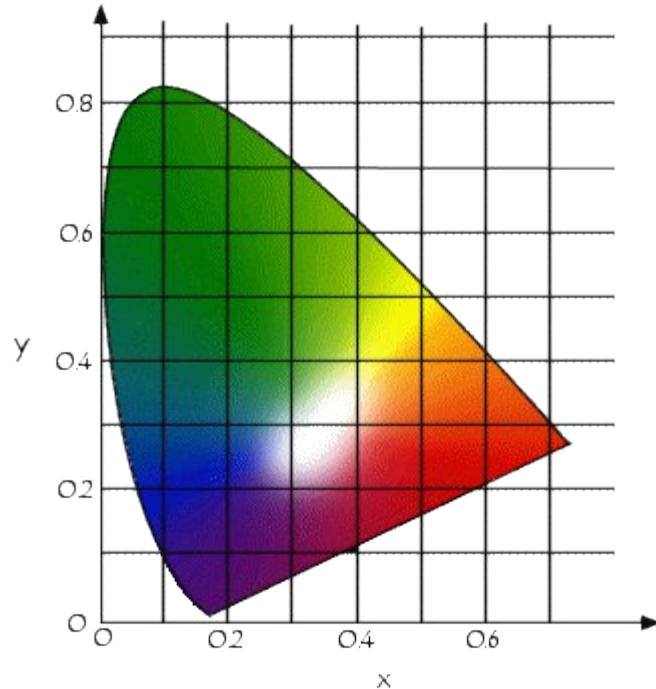
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# Colourspace?

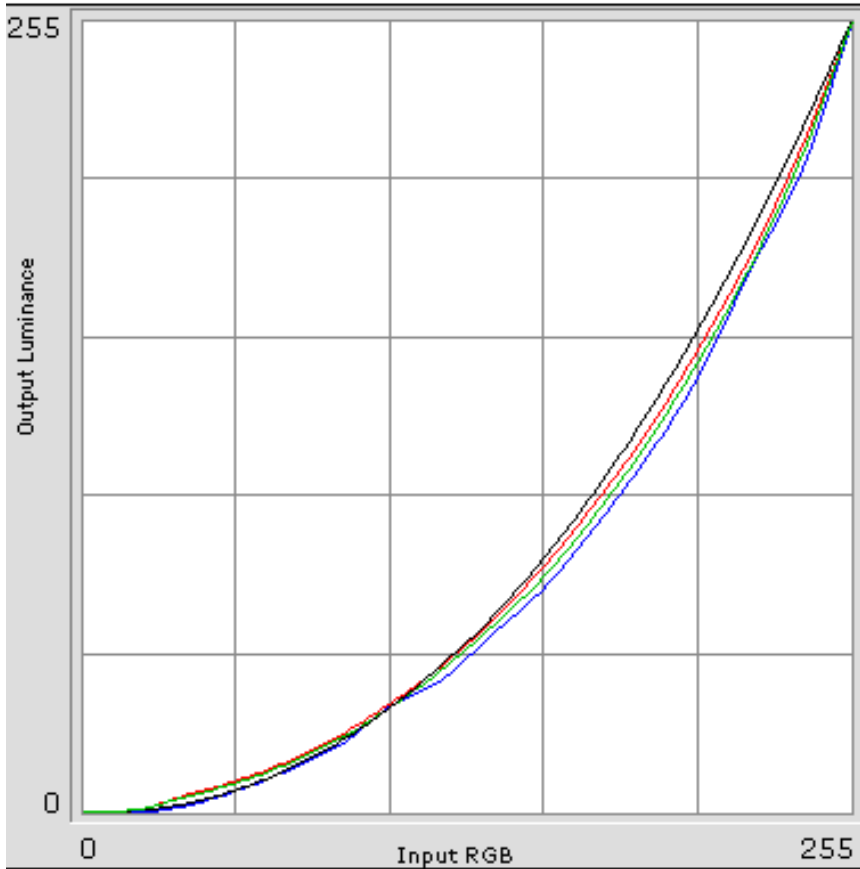
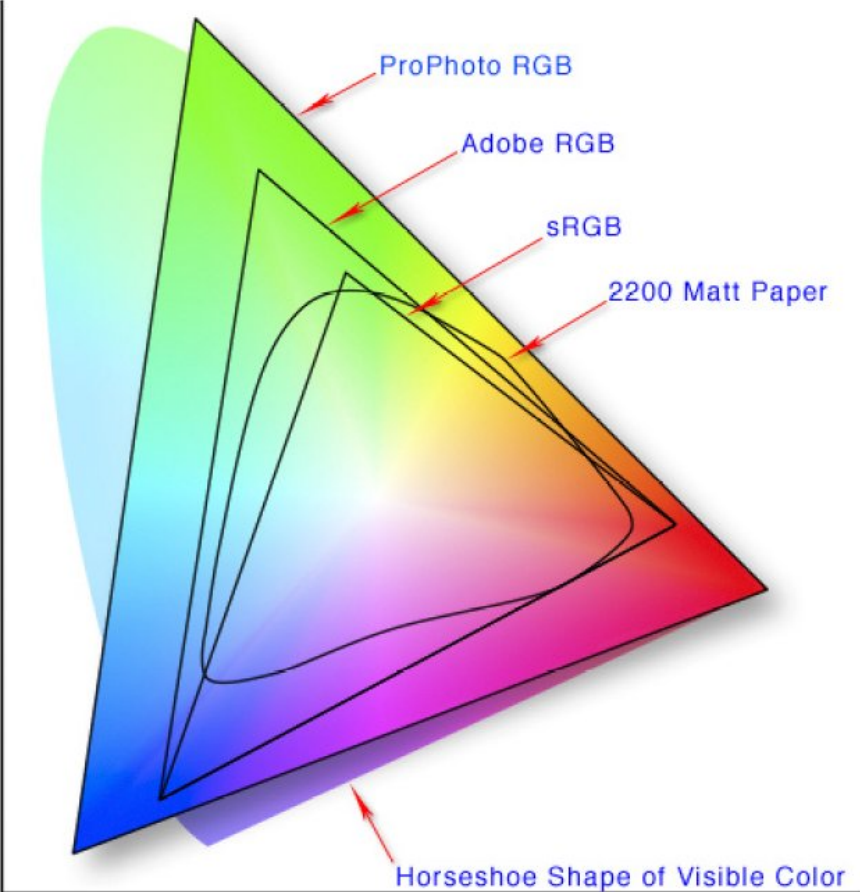


Combination of:

- Colour model (YUV, RGB, CMYK...)
  - Gamut
- Gamma curve

Famous colourspaces:  
AdobeRGB, Rec709, sRGB...

# Gamut and Gamma



# Display technologies

*Monitors:* LCD, LED, Plasma, CRT, OLED, FED...

*Projectors:* DLP, LCD, SXRD, DILA...

All different ways to represent colours



# Right colour?

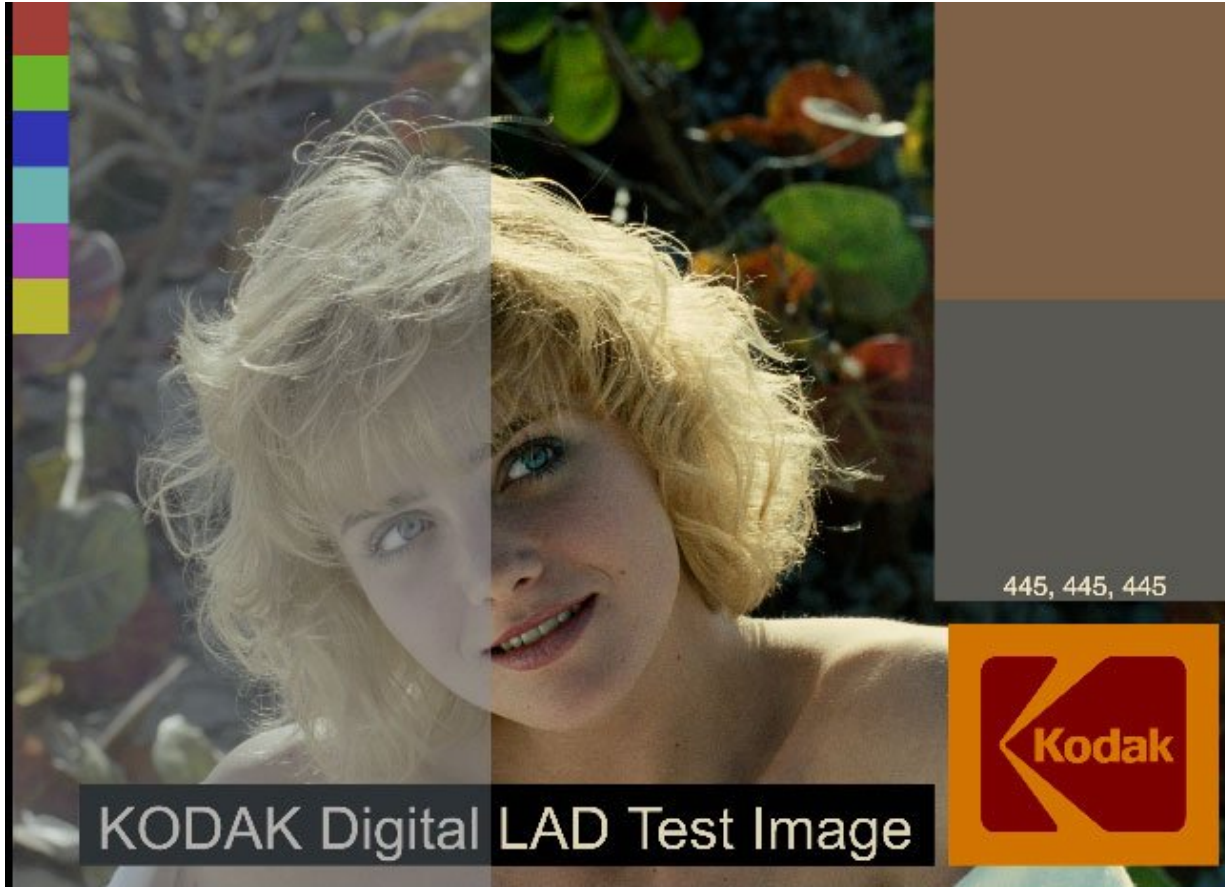


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# Film colourspace



Film has a non-linear  
colourspace (not a  
triangle)  
Every part of the  
process in the lab has a  
different  
gamma/contrast

# DI: Digital Intermediate

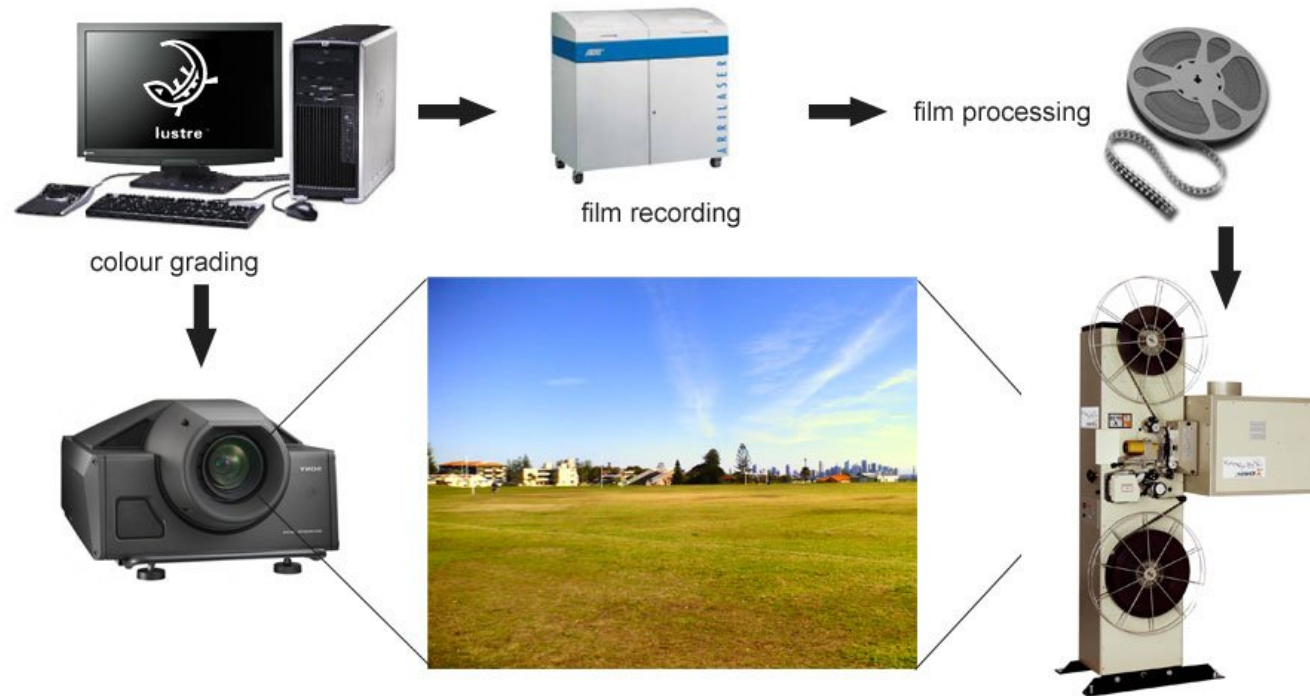
## Film shooting

- Film scanning: neg densities to digital values
  - VFX, colour correction
- Printing film: digital values to densities

With DI, if there is no modification, it would be the same result as if was processed the traditional way

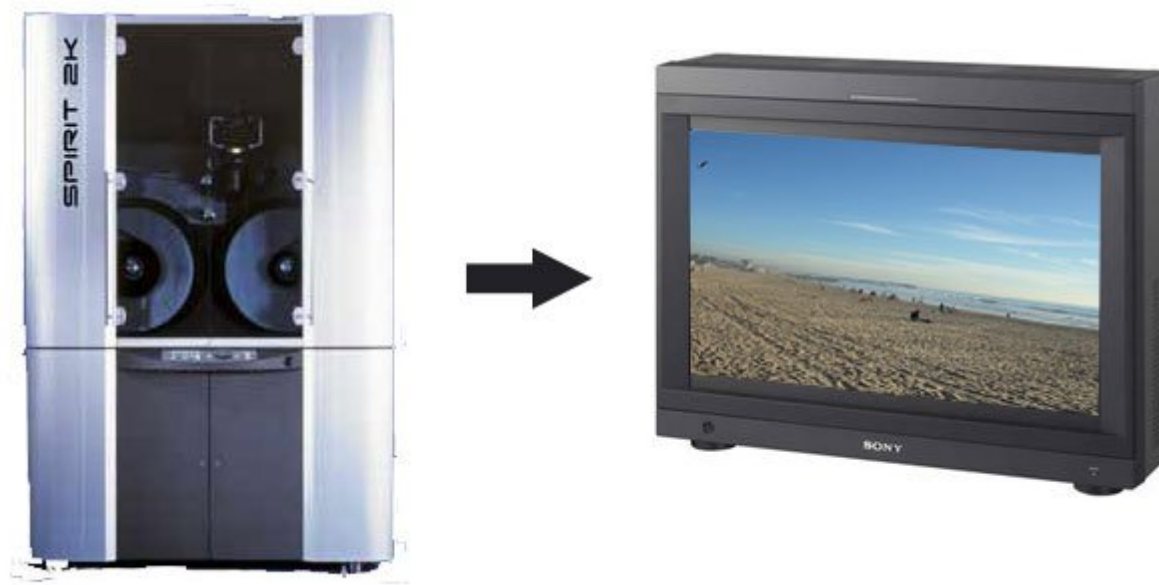
# DI colour management

In Digital Intermediate a film print emulation is applied to the picture to simulate the lab process downstream



# video/telecine grading

The colour grading is done with video monitoring:  
The loop is not closed with film



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# LUTs

The colour management system generates a LUT (Lookup Table)

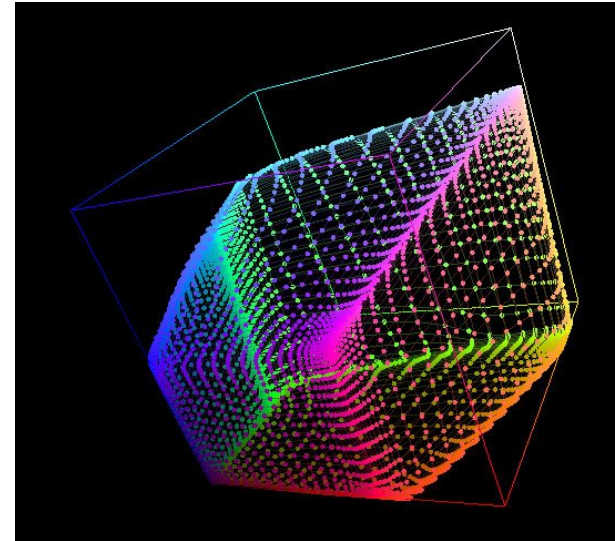
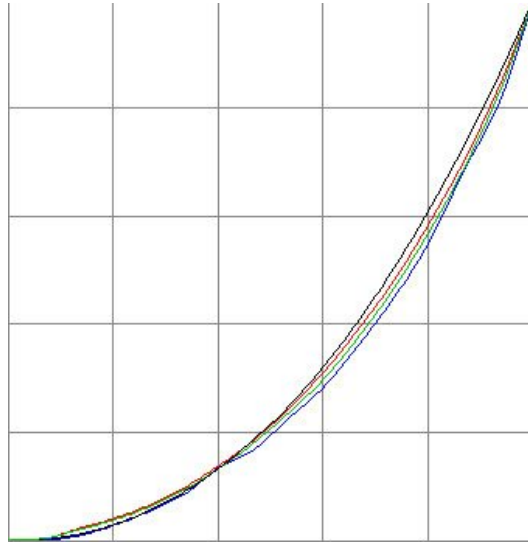
A LUT is a simple text file that links input values to output values

LUTs can represent a lot of things:

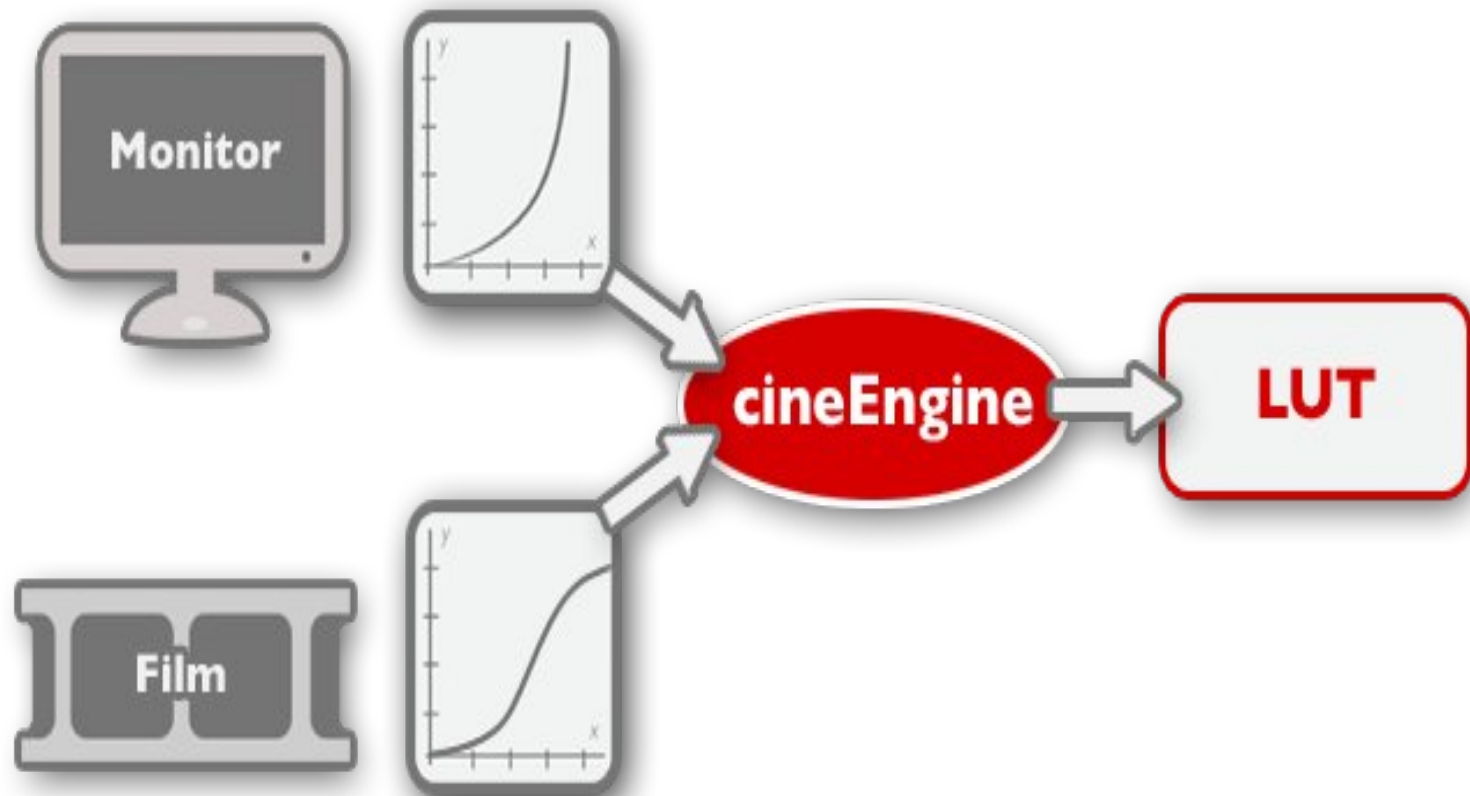
- Technical corrections
  - Artistic input
- Film print emulation
  - Combinations...

# LUTs and dimensions

- 1D LUT: apply the same correction on RGB
- 2D LUT (3x1D LUT) apply different corrections on channels
- 3D LUT: for every RGB colour, remaps to another RGB triplet  
3D LUTs allow management of illegal colours and saturation



# Creating calibration LUTs



Measure the colours  
of the monitoring  
device

Measure the colours  
of the target

Combine them in a  
Colour Management  
System

# Working in a calibrated environment

Calibration of all devices makes communication easier

Everybody sees (pretty much) the same picture

Every device has its own LUT



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# Digital Cinema cameras

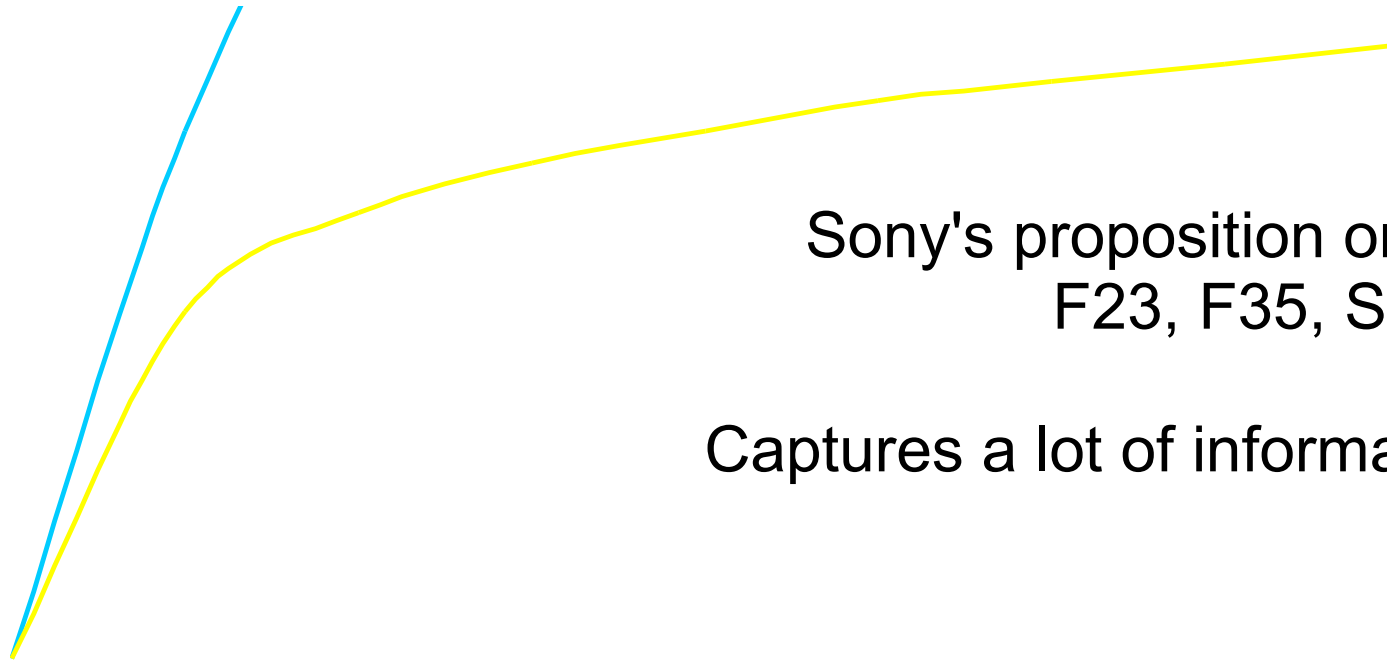


New cameras are able to capture a wider dynamic range. To do so the signal is recorded a different way than traditional video

So there has to be some colour management to see the result as it will be

As opposed to film shooting, there is most of the time a way to monitor the signal onset

# Example: S-Log

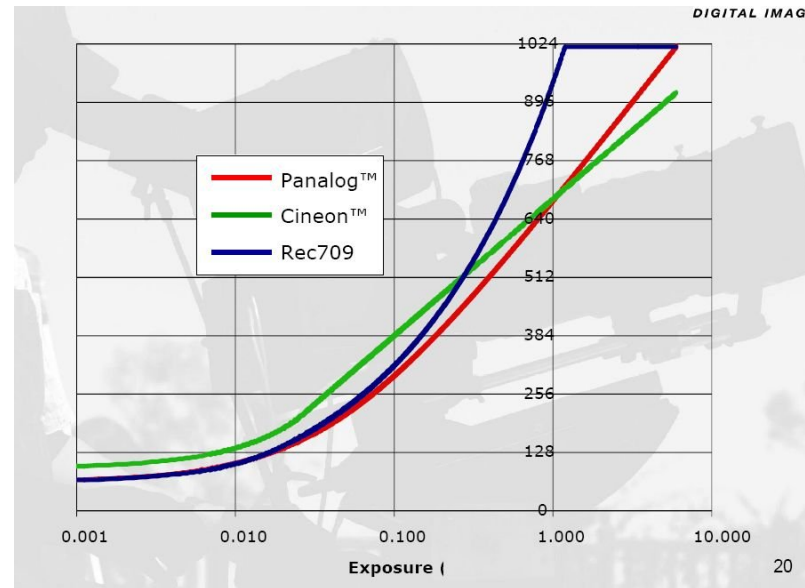


Sony's proposition on Hi-end cameras.  
F23, F35, SRW-9000

Captures a lot of informations in the highlights

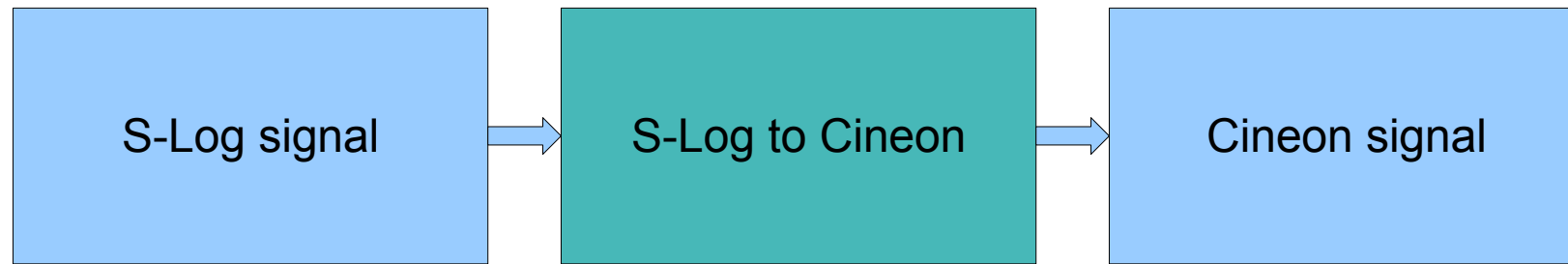
# Log and Cineon

On the market there are a lot of different log:  
RED Log, ARRI Dlog, Panalog, S-Log...



# Log and Cineon

If working with a print emulation LUT it expects a certain type of signal, so it must be converted

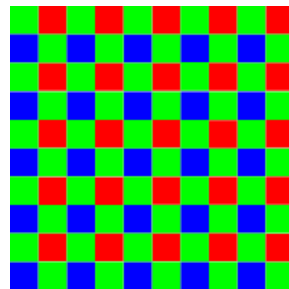


# Bayer cameras

Bayer pattern cameras just capture 1 layer  
RGB is interpolated

There are different ways to demosaic  
Potentially what is monitored onset is significantly  
different to what will be extracted in post

Examples: RED, Silicon Imaging, Arri D21 in Raw mode...



# RAW

The same happens with RAW: there are different types of RAW signals:

- Viper: uncorrected RGB from the sensor
- SI-2K: 12 bit uncompressed Bayer

# Monitoring

With S-Log, the signal monitored out of the camera is the signal actually recorded

**Consistency with Post:** the onset process reproduces the post production process (CC + calibration) to be as close as possible to the final product



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# How to get the right LUT?

Work with the postproduction/lab

Use a Colour Management System

It might also be interesting to generate other LUTs (OoG warning)



# Introducing artistic input

The LUT used onset can integrate some artistic look  
The problem is to document it as it's potentially mixed with other processing  
(conversion, film print emulation...).

The documentation of the colour correction information  
can be set in a standard file: **ASC-CDL**

# ASC-CDL

American Society of Cinematographers - Color Decision List  
A standardized way of documenting and processing colour correction

4 functions (Slope, Offset, Power, Saturation)  
10 Numbers  
XML file format:

```
<ColorDecisionList xmlns='urn:ASC:CDL:v1.01'>
  <ColorDecision>
    <ColorCorrection>
      <SOPNode>
        <Description>WF_CDL</Description>
        <Slope>1.27 1.18 1</Slope>
        <Offset>-0.009 -0.002 0.003</Offset>
        <Power>1 1 1.08</Power>
      </SOPNode>
      <SatNode>
        <Saturation>1.08</Saturation>
      </SatNode>
    </ColorCorrection>
  </ColorDecision>
</ColorDecisionList>
```

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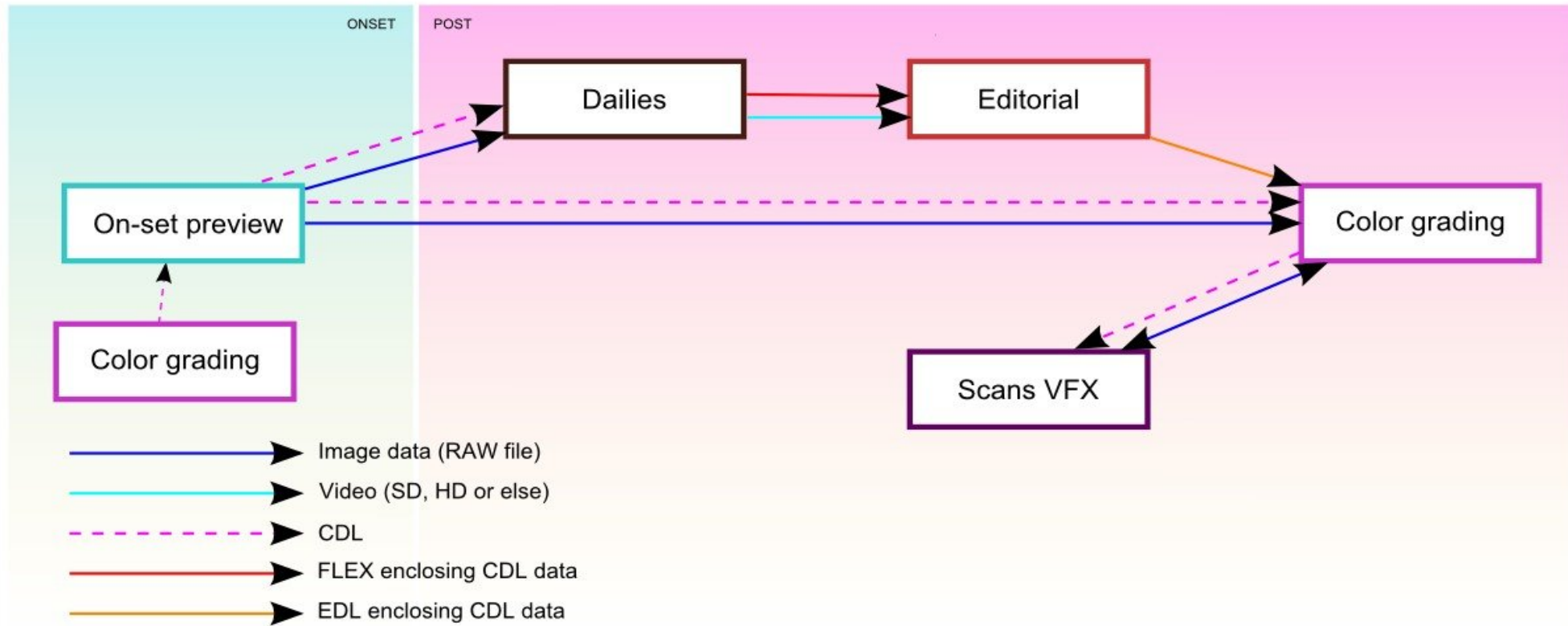
# ASC-CDL

The processing is standard:



Can be passed thru applications and devices

# Workflow example



# CDL usages

- preprod
  - Onset
  - Dailies
    - Vfx
- Final grading

Can be also used for film dailies

# Digital acquisition example



# Differences Video/Film output

Video: every monitor aim at Rec 709  
CDL used for artistic input

Film: CDL used for artistic input, combined with film print emulation LUT  
Limitation: the CDL doesn't document what is before and after in the processing

# Deliverables

The colour management system can do the basic remapping of colours and emulate different final display devices (iPhone, web, etc.)

It will also generate the LUT for XYZ DCP output.

Most of the times a manual adjustment has to be done to compensate the perceptual difference (large/small screen, room darkness, screen distance...)



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# The end of DI?

Film scanning progressively replaced by digital acquisition

Film recording progressively replaced by digital projection

Colour management is even more critical: less standards,

**What is the reference?**



Today just a portion of the colours possible in digital projection are used because main aim is film. In the future wide gamut could be considered.

# Conclusion

Today the possibilities are in numbers

Communication between camera dept and post is more important than ever

Some little changes can help saving a lot of money

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# Thank you!

Thanks to Autodesk for organizing this workshop

Thanks to Famous for the Viper Camera

Thanks to FutureWorks for the CineTal monitor

Don't hesitate if you have questions:

*cedric@workflowers.net*

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