THE TEXTURE AND THE 4K/UHD WORKFLOW
HOW TO CONTROL THE SHARPNESS
SHORT VERSION

A PRESENTATION FROM
THE IMAGO TECHNOLOGY COMMITTEE
PRESENTATION SUMMARY: **SHORT VERSION**

**THE TEXTURE AND THE 4K WORKFLOW**

Texture and look of the image, how to control the sharpness.

**CHAPTERS:**

1. - Camera & Sensors - Reminder
2. - The Shooting Parameters - Monitoring
3. - The Type of Lighting Fixtures
4. - Camera: Sensor, OLPF and MTF
5. - The Role of the Detailing System in Camera
6. - Sharpness & Postproduction - Monitoring & Screening
7. - Sharpness & Release - Monitoring & Screening
8. - Camera & Lenses - The Paradox
9. - Texture Control - Which Tools?
10. - Example of Confusion
11. - Conclusions
12. - ARRI Texture Tools - Only in FULL VERSION
13. - Example: Film 'Cartas da Guerra' - Only in FULL VERSION
SPECIAL THANKS TO:

DAVID STUMP
ASC

ROBERTO SCHAEFER
ASC AIC

This presentation includes several slides shown at Camerimage 2017 during the:

ASC / IMAGO PANEL
The importance of Cinematographer’s Collaboration Beyond Borders
WHY IS IT INTERESTING TO LINK THE TEXTURE TO THE UHD/4K WORKFLOW?

Of course the specificities and issues related to the texture exist also in a 2K workflow, but shooting in UHD/4K reveal in a most flagrant way some peculiarities as well as some difficulties encountered by filmmakers, cinematographers, colorists to name but a few when they intend to control the texture.
WHY IS IT INTERESTING TO LINK THE TEXTURE TO THE UHD/4K WORKFLOW?

In addition to highlighting some facts, this presentation intend to create a debate and to question both users and manufacturers.

The Imago Technology Commitee launched:

IMAGO SURVEY REQUESTS TO MANUFACTURERS

https://www.umfrageonline.com/s/Manufacturers_request

Develops several topics described in this part.
SOME WORDS FOR TEXTURE

For science
- Definition
- Detailing

For perception
- Sharpness
- Accutance (Combination of detailing & Micro contrast)

**Definition**: number of pixels related to frame ratio. Ex: 4K, for Flat (1.85:1) = 3996 x 2160 pixels

**Resolution**: pixel density: number of pixels/square inch
SEMANTICAL ISSUES
SEMANTICAL ISSUES

Different words, different meanings

- Sharpness
- Over sharpness
- Sharpen
- Sharpening
- Detail Level
- Detailing

Detailing has different meanings for each manufacturer
CONTROL OF THE TEXTURE

What is at stake:

Conveying emotion & meaning
THE SHARPNESS AND THE 4K WORKFLOW

1 - CAMERA & SENSORS - REMINDER
For the sake of clarity and vulgarisation, the following tables intentionally excludes, among other things:

- The size of the sensor
- The number of photosites
- The number of photosites dedicated for the image
- The size of the photosites
- The photosite pitch
- The type of lenses
- The type of post-production
<table>
<thead>
<tr>
<th>Cameras</th>
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<td>Alexa XT (Raw Recording w/ Open gate)</td>
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CONFUSION

- These cameras deliver all the same definition (resolution)
- But they aren’t delivering the same texture and the same sharpness
QUALITY AND NUMBERS

- The number of pixels on a display or on a screen defines an HD, 2K, UHD or a 4K image without any information on the perception of sharpness.

- The lack of standardization and real characteristics leads to several difficulties regarding the perfect understanding of what the quality of a 4K image means.
THE SHARPNESS AND THE 4K WORKFLOW

2 - THE SHOOTING PARAMETERS
2 - THE SHOOTING PARAMETERS: CAMERA

Camera
✓ Type of sensor
✓ Recording file types specificities
✓ Setting (Gamma/Sharpness/OLPF…)
✓ Noise reduction
Before choosing glass filters the choice of lighting fixtures and diffusion remains essential.

See chapter 3 in FULL VERSION THE TYPE OF LIGHTING FIXTURES
The perception of sharpness depend also on the structures and colors of the backgrounds and foreground. It also depends on the results of the depth of field on these backgrounds and foregrounds.
THE SHOOTING PARAMETERS

- Structure of the skin
- Type of make-up Costumes
- Type of lighting fixtures
- Type of Lenses Aperture
- Type of cameras

The quality of the internal deBayer lead to different perception of texture
Different strategies of glass filtering on set have been used since the early days of the digital era......
Question:
Can we easily choose glass filtering with an EVF?

Answer:
We can’t, we don’t see much…
THE SHOOTING PARAMETERS: GLASS FILTERING AND VFX

Question:
Can we easily use glass filtering when we are shooting with VFX?

Answer:
VFX department don’t allow the use of glass filtering…
Using a 4K monitor can lead to additional expenses for the whole shoot. It is best used during the tests to choose the glass filters and to check the texture.
Using a 4K monitor can lead to additional expenses for the whole shoot. It is best used during the tests to choose the glass filters and to check the texture.
2 - THE SHOOTING PARAMETERS

Parameters

- Camera - type of sensor*
  - Recording file types specificities
  - Setting (Gamma/sharpness/OLPF…)
  - Noise reduction
- Lens & Aperture
- Glass filtering

- Type of lighting
- Lighting fixtures - type/diffusion
- Texture of the skin / Make-up
- Costume
- Density of atmosphere: particles/fog/dust…
- Set design/Background/Foreground

*In this presentation, we only focus on CMOS cameras. Different sensors: different textures.
2 - THE SHOOTING PARAMETERS

TOO MANY PARAMETERS!
Without reference displays or professional screenings, deciding about a level of sharpness is quite impossible.
THE SHARPNESS AND THE 4K WORKFLOW

3 - THE TYPE OF LIGHTING FIXTURES
Since the arrival of digital cameras many manufacturers have designed systems to soften the lights. Due to the oversharpness?

The LED, even with different levels of qualities, and the diffusion systems became quite ubiquitous.
3 - THE TYPE OF LIGHTING FIXTURES

VISUAL SHARPNESS AND LED

Initiated by cinematographer, John-Christian Rosenlund, an LED test was launched on August 30th. 2016 in cooperation between the FNF (Norwegian Society of Cinematographers) and the NRK (Norwegian Broadcasting Corporation)

https://www.led-light-test.com
https://www.led-light-test.com/the-idea-behind
The plans of the EU are to restrict the use of tungsten halo lights also in theater and film use.

https://www.ald.org.uk/resources/savetungsten
3 - THE TYPE OF LIGHTING FIXTURES

RISKS

• Lack of fixtures to create nice shadows

• Uniformity of lighting

QUESTIONS:

• Do all new LED tools combined with medium range file recording systems or even raw files fit with the minimum of quality expected by filmmakers?

• Do we still have the means to create easily, drama with the lighting fixtures?

See chapter 3 in FULL VERSION
THE SHARPNESS AND THE 4K WORKFLOW

4 - CAMERA: SENSOR, OLPF AND MTF
4 - CAMERA: SENSOR, OLPF AND MTF

Parameters

- Camera - type of sensor
  - Recording format specificities
  - Setting (Gamma/sharpness/OLPF…)
  - Noise reduction
- Lens & Aperture
- Glass filtering
- Type of lighting
- Lighting fixtures - type/diffusion
- Texture of the skin / Make-up
- Costume
- Density of atmosphere: particles/fog/dust…
- Set design/Background/Foreground
THE ROLE OF THE SENSOR

Lens

Bayer pattern / sensor

Camera
DeBayer means the same thing than Demozaicking.
There are no pixels on a sensor but photosites.
THE ROLE OF THE SENSOR

Anisotropic

Isotropic

Courtesy of David Stump ASC
THE ROLE OF THE SENSOR

*Courtesy of David Stump ASC*

A marriage between two very different worlds

Anisotropic  Isotropic
4 - CAMERA: SENSOR, OLPF AND MTF

THE ROLE OF THE SENSOR
The pitch between the photosites create a lack of information to reproduce the image.
THE ROLE OF THE SENSOR

Fixed pattern vs oscillating pattern

The Delta Penelope

Joe Dunton MBE, BSC & Jean-Pierre Beauviala
**THE ROLE OF THE OLPF**

OLPF: Optical Low-Pass Filter): blurs to keep away from aliasing
THE ROLE OF THE OLPF

Aliased

Anti-Aliased
THE ROLE OF THE OLPF

Minimal aliasing

Courtesy of RED
THE ROLE OF THE OLPF

Strong aliasing

Courtesy of RED
THE ROLE OF THE MTF

Lens → MTF → Camera

OLPF

Bayer pattern/sensor
MTF ?

MODULATION  TRANSFER  FUNCTION %

Courtesy of David Stump ASC
MTF - Only for lenses?

MODULATION  TRANSFER  FUNCTION  %

Courtesy of David Stump ASC
4 - CAMERA: SENSOR, OLPF AND MTF

SEVERAL MTF

Bayer pattern/sensor

Camera

Lens

MTF

OLPF

MTF
MTF - For camera

MODULATION → TRANSFER → FUNCTION %
MTF - For the workflow

MODULATION  TRANSFER  FUNCTION  %

LENS/ CAMERA  POST- PRODUCTION  PROJECTORS/ DISPLAYS
THE SHARPNESS AND THE 4K WORKFLOW

5 - THE ROLE OF THE DETAILING SYSTEM IN CAMERA
5 - THE ROLE OF THE DETAILING PROCESS IN CAMERA

MTF: Modulation Transfer Function
Due to the OLPF (among other parameters), there is an important need to increase the sharpening/detailing setting, internally for a codec or in post for raw materials. This is the role of the detailing system.
Who is in charge to control the level of sharpness?

Engineers?
Cinematographers?
Colorists?
TWO IMPORTANT CHARACTERISTICS OF DETAILING

• The detail level of an image is always easy to increase in post.

• But it’s always very difficult and expensive to lower the detail level in post.
FIRST CONCLUSIONS

- DETAIL PARAMETERS ARE DEFINED BY SKILLED ENGINEERS
- BUT DO THESE PARAMETERS FIT WITH ALL THE AESTHETIC WISHES OF FILMMAKERS?
CONTROLLING THE LEVEL OF DETAIL IS A KEY PARAMETER IN THE PROCESS OF THE IMAGE TEXTURE
THE SHARPNESS AND THE 4K WORKFLOW

6 - SHARPNESS & POST-PRODUCTION
6 - SHARPNESS & POST-PRODUCTION

MTF - For camera

MODULATION ➔ TRANSFER ➔ FUNCTION %

Detailing process

Which level?
Who is in charge of the control?

Same question if we are shooting in Raw:

How can we choose a lens if we don’t have access to this detailing process?
Parameters (w/o parameters of viewing distance)

- Type of recording
- DeBayer
  - Onboard
  - Post-production
  - Sharpness control
- Gamma encoding/Color mapping

- Grading
  - Sharpness modifications
    - "Refocus"/"Defocus"
    - Noise reduction
    - Texture creation - Grain (size/speed)
- HDR
- HFR (time resolution)
6 - SHARPNESS & POST-PRODUCTION

Parameters (w/o parameters of viewing distance)

TOO MANY PARAMETERS!
The sharpness (detail) control embedded in the deBayer process in post is not given by all manufacturers. Example: Sony
6 - SHARPNESS & POST-PRODUCTION

GLASS FILTERING VS DIGITAL FILTERING

**PROS & CONS**

**GLASS FILTERING**
- Low cost
- Limitations:
  - Permanent alteration
  - Affects whole image
  - Issues when travelling from wide shot to close-up or vice versa.

**DIGITAL FILTERING**
- Infinite range of possibilities (area base filtering, luminance & hue)
- High costs
- Time consuming
HDR, HFR AND TEXTURE

- High Dynamic Range and High Frame Rate are influencing the perception of texture.
- No serious studies have been done on these new topics.
THE SHARPNESS AND THE 4K WORKFLOW

7 - SHARPNESS & RELEASE
**Parameters** (w/o parameters of viewing distance)

**SCREENING projectors (DCI)**
- Resolution
- Speed - HFR
- Type of projector (Laser)
- Sharpness decision by manufacturers
- HDR/Color space

**EMMISIVE SCREENING - LED**

**No standard**

**BROADCASTING**
- Different types of transportation/compression
- Resolution
- Speed - HFR
- Types of displays
- HDR/Color space
- All parameters possible (Gamma, Cine Style, Sharpness, etc)
7 - SHARPNESS & RELEASE

SIZES & PERCEPTIONS

SHOOTING

Electronic Viewfinder → Onboard deBayer → HD Monitors → 4K Monitors

POST-PRODUCTION

Grading session

4K/UHD Display

BROADCASTING - VOD

UHD TV → Home cinema

THEATER RELEASE

Projector projecting on screen
• Different steps
  • Different sizes of screens
  • Different environments
  • Different perceptions
The texture and specifically the sharpness have to be checked through a simulation of the final release. For theater release only a large screen can give the level of sharpness.

4K screening or UHD large displays are changing our perceptions as spectator, they change cinematographers and postproducers and colourists methodologies.
THE SHARPNESS AND THE 4K WORKFLOW

8 - CAMERA & LENSES: THE PARADOX
CHOOSING LENSES

- Nowadays, choosing a set of lenses often becomes the most important phase of tests.
- The combination of camera and lenses became a new challenge.
- The 4K workflow highlights the flavour of the lenses in a more obvious way than the 2K one.
Lens manufacturers are working hard on the control of sharpness, bokeh and texture, but more easily, thanks to mathematics and algorithms.

The new larger sensors (Red, Arri, Sony, Canon) as well as the new lenses (Leica, Zeiss, Arri, Panavision) for these new cameras should lead to new strategies to control the unwanted oversharpeness.
CONTROL OF THE TEXTURE

LENSES MANUFACTURERS STRATEGIES

- “Clever” lenses - Cooke /i
- “Clever” lenses - Arri/Zeiss LDS
- “Clever” lenses - Panavision
- “Clever” lenses - Zeiss eXtended Data
VINTAGE LENSES AND DIGITAL CAMERAS

A COMPLEX STORY
Many cinematographers are often using vintage lenses to create a look, but more often, it is for lowering the crisp look of several cameras.

Question: Are we creating a look or are we fighting against the machine, or both?
Question: Are we sure that we know all the parameters of texture given by the camera?
Question:
How can we choose a lens if we don’t have access to this detailing parameter?
THE SHARPNESS AND THE 4K WORKFLOW

9 - TEXTURE CONTROL - WHICH TOOLS?
An interesting step for the texture has been given by SONY several years ago to create gamma encoding.

The CVP FILE EDITOR customized Gamma curve.

The gamma encoding plays an important role in the perception of sharpness.
9 - TEXTURE CONTROL - WHICH TOOLS?

EXAMPLES: SONY

New parameters?

Not really, the first HD ENG cameras starting with the Sony F900 provided through the PAINT MENU a lot of control on the perception of sharpness.

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<th>DETAIL</th>
<th>LEVEL 1</th>
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A first step already given by camera manufacturers:

- On some codecs:
  - ARRI on Mini and Amira with ProRes,

  SEE FULL VERSION chapter 12

  - SONY with XAVC, but with limitations to lower the details
EXAMPLES:

A first step already given by camera manufacturers:

- On RAW footage in post:
  Access to control of sharpness during deBayer with: ARRI, RED, PANAVISION, CANON, PANASONIC
EXAMPLES:

Some post tools:

- BASELIGHT:
  THE NEW TEXTURE EQUALISER OPERATOR

- DAVINCI:
  RESOLVE FX FACE REFINEMENT
THE SHARPNESS AND THE 4K WORKFLOW

10 - EXAMPLE OF CONFUSION
NETFLIX

Requirements
10 - EXAMPLE OF CONFUSION

NETFLIX

Requirements

Requirements

- Confusion between photosites and pixels
- Cameras like RED Weapon or Sony F65 are at the same level of a C300 MKII or an URSA
- Alexa (Open gate) is not mentioned
- Lenses aren’t mentioned
THE SHARPNESS AND THE 4K WORKFLOW

11 - CONCLUSIONS
All these parameters, previously described - quite complex - gave cinematographers a control of the texture of the image.

Many filmmakers and cinematographers are fighting against a feeling of over sharpness when they use a 4K workflow.

The combination of camera and lenses is a key parameter to control the texture.

The combination of “sharp” cameras and soft lenses or vintage ones often gives interesting results but without a controllable approach.
REMINDER: PARAMETERS - DETAILING SYSTEM - LENSES

- Due to the OLPF (among other parameters), there is an important need to increase the sharpening/detailing setting, internally for a codec or in post for raw materials. This is the role of the detailing system”

- Do we know what level of detail is used in a camera or in post?

- Who is deciding about this level?

- Engineers, colorists or/and cinematographers?

- Do we need similar controls available in the former HD cameras?
REMINDER: PARAMETERS - DETAILING SYSTEM - LENSES

- Or could new algorithms create other ways to deal with the static pattern of the digital image (Similar to Arri detailing parameters or Filmlight texture equaliser)?

- Some manufacturers have opened these controls in their cameras, like Arri in the Alexa Mini & the Amira. Arri gives its factory level of sharpness and a way to compare the different values to increase or reduce the detailing parameters. See slides 163 to 175 in FULL VERSION: ARRI TEXTURE TOOLS

- The choice of the lighting fixtures is important in the general process of texture
REMINDER: PARAMETERS - DETAILING SYSTEM - POST

- When shooting in RAW the detailing control is not always available in post after the deBayer process
- It can lead to expensive and time consuming texture control during the grading session
CONCLUSIONS 1/2

• The role of sharpness through the detailing system is a key point in the control of the texture

• Choosing a lens without access of detailing control on the camera or in post is leading to some important limitations or confusions

• If cinematographers don’t have these parameters reachable, they often have to fight against the machine.
• Cinematographers/colorists always find strategies to deal with oversharpness, but at what price?

• Theoretically, we have all the means to improve the creative aspects of the cinematographers craft

• We just need to have, from manufacturers, some more open doors, including the detailing parameters
Special thanks to:

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Laurent Desbrueres - Senior colorist  
Thomas Eberschveiler - Workflow Consultant - Filmlight GMBH  
Erwan Le Cloirec - Post-production instructor/Founder of yakyakyak  
Richard Lewis - Chief engineer Cinematography & 4K Application Specialist - Sony  
Jean-Yves Martin - Product Specialist Broadcast & Cinema – Sony  
Benoit Mercier - National Sales Manager - Canon  
Andy Minuth - Colour - Workflow Specialist / Colorist - Filmlight GMBH  
Christian Mourier - Engineer - Consultimage  
Fabien Pisano - Sales Head South Europe - Sony  
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For the checking of grammar & English!

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Presentation initiated and designed by:
Philippe Ros Cinematographer AFC
with the help of all my colleagues acknowledged in the last three slides

Philippe Ros is co-chairman of the Imago Technology Committee with Mick van Rossum Cinematographer NSC