Data Migration, Our Frenemy

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No Time to Wait!
Open Media, Open Formats, Open Archives
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The Reel Thing XLII
New Orleans, Louisiana, USA
29 November 2017

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Lessons Learned

Data Migrations

2014

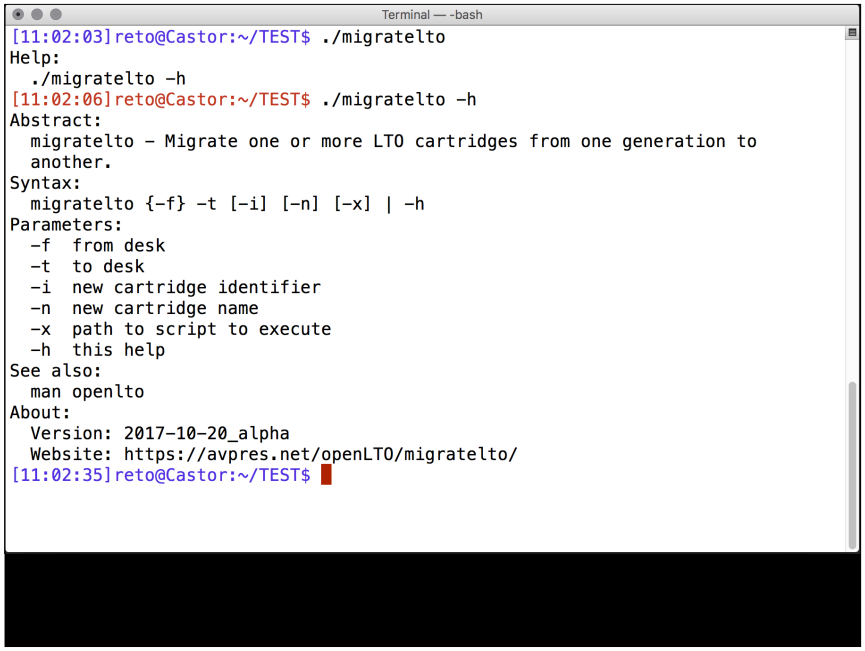
- our internal archive from LTO-4 to LTO-6 (5.7 PB)

2014–2017

- […]

2017

- a client's archive from LTO-5 to LTO-7 (270 GB)



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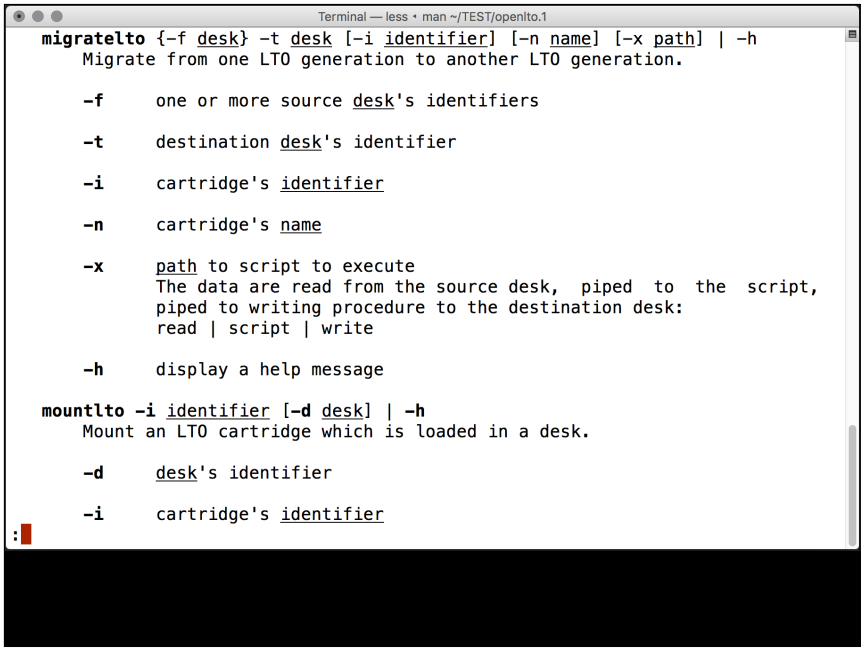

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read | script | write

script to modify

- container
- codec
- both container and codec

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Examples

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Video

from:

- AVI / 8-bit and 10-bit uncompressed
- MOV / 8-bit and 10-bit uncompressed
- MP4 / 8-bit and 10-bit uncompressed

to:

- Matroska / FFV1

Container and Codec

→ read file from source LTO
→ demultiplex file
→ decode file

- $Y'C_BC_R$, 4:2:2, 8 bit, «raw» [uyvy422]

→ encode file
→ multiplex file
→ write file to destination LTO

Container and Codec

→ read file from source LTO
→ demultiplex file
→ decode file

- $Y'C_BC_R$, 4:2:2, 10 bit, «raw» [yuv422p10le]

→ encode file
→ multiplex file
→ write file to destination LTO

Film

from:

- TIFF
- DPX

to:

- Matroska / FFV1 using RGB48 and additional metadata

Reading

Reto Kromer: **Matroska and FFV1: One File Format for Film and Video Archiving?**, in «Journal of Film Preservation», n. 96 (April 2017), FIAF, Brussels, Belgium, p. 41–45

➔ https://retokromer.ch/publications/JFP_96.html

Old Experimentations

from:

- AVI / HuffYUV
- AVI / FFV1 version 1

to:

- Matroska / FFV1 [version 3]

Mid_{old} Experimentations

from:

- AVI / CineForm (VC-5) with Bayer
- MOV / CineForm (VC-5) with Bayer
- MOV / ProRes

to:

- Matroska / FFV1 after de-mosaicking
- Matroska / ProRes

Container, Codec and Data

➔ read file from source LTO
➔ demultiplex file
➔ decode data
  - 12 bit [bayer_bggr16le]
➔ encode data
➔ multiplex file
➔ write file to destination LTO

Container, Codec and Data

- → read file from source LTO
- → demultiplex file
- → decode data
  - R′G′B′, 4:4:4, 16 bit, «raw» [rgb48le]
- → encode data
- → multiplex file
- → write file to destination LTO

Container, Codec and Data

- → read file from source LTO
- → demultiplex file
- → decode data
- → **filter data (de-mosaic)**
- → encode data
- → multiplex file
- → write file to destination LTO

Container

- → read file from source LTO
- → demultiplex file
  - ProRes 422, 10 bit [yuv422p10le]
  - ProRes 4444, 10 bit [yuv444p10le or yuva444p10le] or 12 bit [yuv444p12le]
- → multiplex file
- → write file to destination LTO

Mid_{new} Experimentations

from:

- AVI / CineForm (VC-5) with Bayer
- MOV / CineForm (VC-5) with Bayer
- MOV / ProRes

to:

- Matroska / FFV1 version 4 [with Bayer]
- Matroska / ProRes with 12-bit support

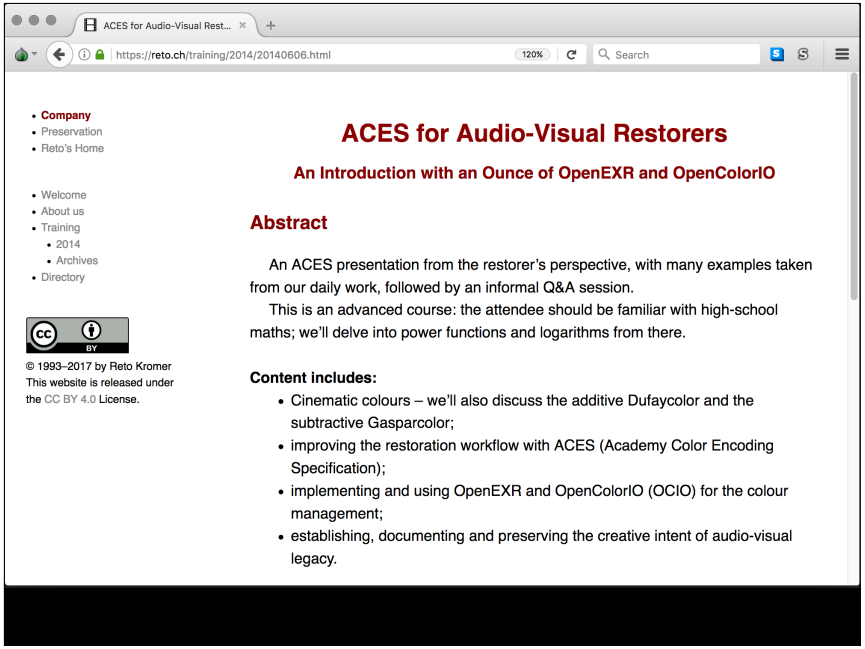
New Experimentations

from:

- MXF / OpenEXR
- flavour of NUT / multiple RGB48
- flavour of NUT / RGB72 or $Y'C_BC_R$ 24-bit
- flavour of NUT / expanded OpenEXR

to:

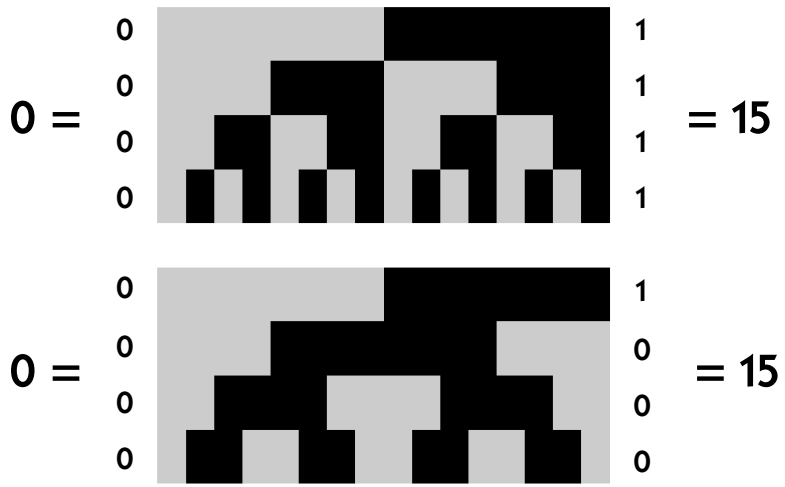
- Matroska / FFV1 version 4 using RGB48, RGB72, floats and additional metadata



Wishes

EBML

- additional support:
  - ➔ Gray codes



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Matroska

- additional metadata
- additional integration:
  - → 1D LUT
  - → 3D LUT
- additional support:
  - → Gray codes

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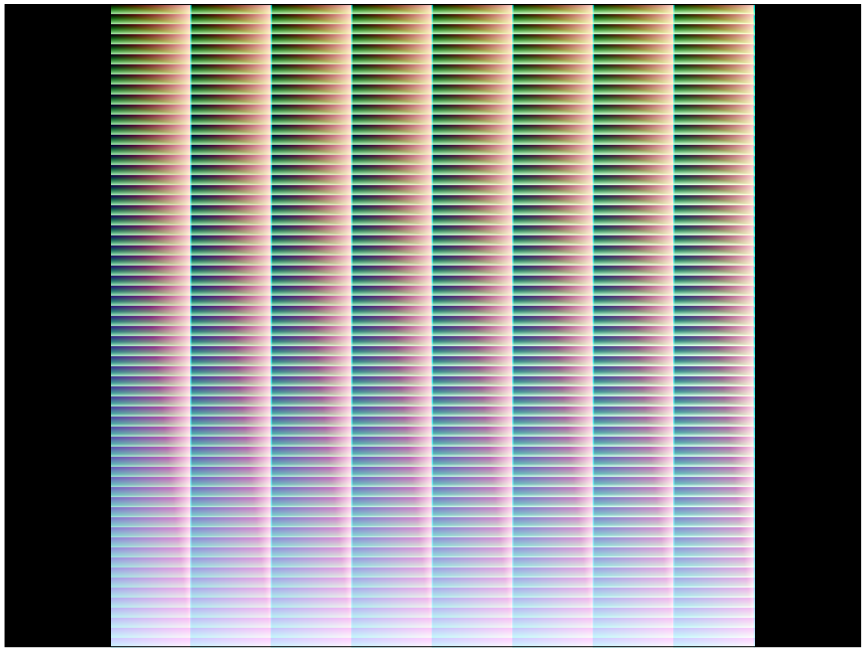

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FFV1

- additional metadata
- additional encoding:
  - → RGB72, $Y'C_BC_R$ 24-bit and floats
  - → Bayer
- additional support:
  - → Gray codes
  - → $Y'C_OC_G$

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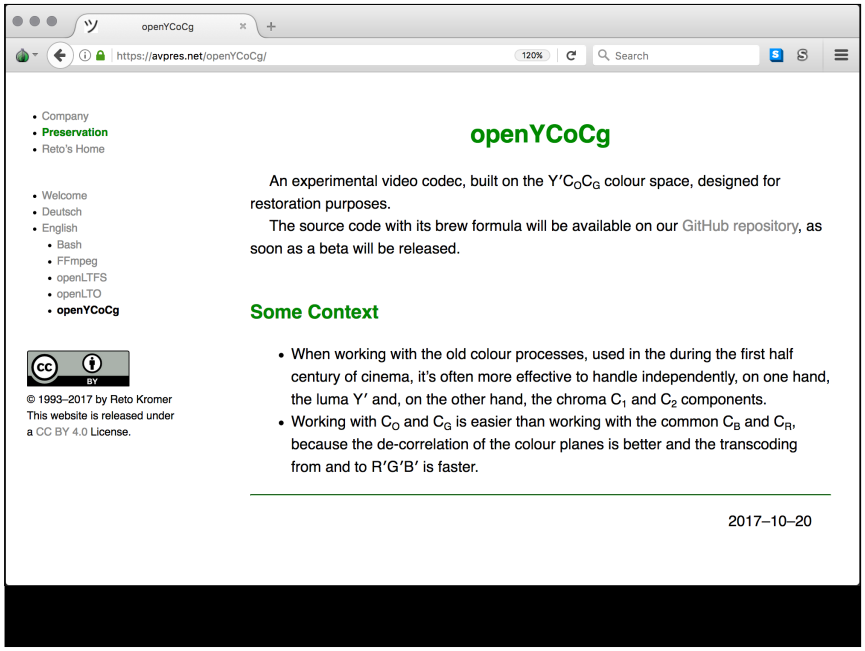

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$$\begin{pmatrix} R' \\ G' \\ B' \end{pmatrix} = \begin{pmatrix} 1 & 0 & 1.396523 \\ 1 & -0.342793 & -0.711348 \\ 1 & 1.765078 & 0 \end{pmatrix} \begin{pmatrix} Y' \\ C_B \\ C_R \end{pmatrix}$$

$$\begin{pmatrix} Y' \\ C_B \\ C_R \end{pmatrix} = \begin{pmatrix} 0.299 & 0.587 & 0.114 \\ -0.168074 & -0.329965 & 0.498039 \\ 0.498039 & -0.417947 & -0.080992 \end{pmatrix} \begin{pmatrix} R' \\ G' \\ B' \end{pmatrix}$$

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$$\begin{pmatrix} R' \\ G' \\ B' \end{pmatrix} = \begin{pmatrix} 1 & 1 & -1 \\ 1 & 0 & 1 \\ 1 & -1 & -1 \end{pmatrix} \begin{pmatrix} Y' \\ C_O \\ C_G \end{pmatrix}$$

$$\begin{pmatrix} Y' \\ C_O \\ C_G \end{pmatrix} = \begin{pmatrix} \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \\ \frac{1}{2} & 0 & -\frac{1}{2} \\ -\frac{1}{4} & \frac{1}{2} & -\frac{1}{4} \end{pmatrix} \begin{pmatrix} R' \\ G' \\ B' \end{pmatrix}$$

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FLAC

- additional support:
  → Gray codes
- additional encoding:
  → 24-bit sample format

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Kate Murray:

«More adoption means better sustainability.»

[while proudly speaking about MXF/JPEG 2000 at the Matroska/FFV1 symposium in Vienna]

Matroska Reader

- full transparency with DPX [et similia]
  - → RAWcooked
- create, alter and inspect Matroska files
  - → MKVToolNix
- verify Matroska and WebM files
  - → mkvalidator

Matroska Player

- apply 1D and 3D LUT to the video stream
  - → VLC
  - → mpv
  - → ffplay
  - → FFmpv

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