

FFmpeg-Workshop

Reto Kromer • AV Preservation by reto.ch

Digital Files
Hochschule der Künste Bern
1. Juni 2022

1

Benutzerschnittstellen

- Lochkarten und Matrixdrucker
- Kommandozeile
(Englisch: command-line interface = CLI)
- grafische Benutzeroberfläche
(Englisch: graphical user interface = GUI)
- berührungslose Schnittstellen

2

ASCII (1977/1986)																
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0x	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
1x	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2x	SP	!	"	#	\$	%	&	'	()	*	+	,	-	.	/
3x	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4x	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5x	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
6x	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7x	p	q	r	s	t	u	v	w	x	y	z	{		}	~	DEL

Legend:
■ Changed or added in 1963 version
■ Changed in both 1963 version and 1965 draft

3

Software

4

Die FFmpeg-Familie

Programme

- ffmpeg
- ffprobe
- ffplay

Bibliotheken

- libavcodec
- libavformat
- libavfilter
- libavutil
- libavdevice
- libswscale
- libswresample
- libpostproc

5

Programmbibliotheken

demultiplexen: libavformat

decodieren: libavcodec

ändern: libavfilter

codieren: libavcodec

multiplexen: libavformat

6

Dateiumwandlungen

ffmpeg (CLI)

→ ffmpeg.org

FFmpeg Cookbook for Archivists

→ avpres.net/FFmpeg/

ffmprovisr

→ amiaopensource.github.io/ffmprovisr/

7

Metadaten extrahieren

MediaInfo (GUI, CLI)

→ mediaarea.net/MediaInfo

ffprobe (CLI)

→ ffmpeg.org

8

Mediaplayer

VLC (GUI)

→ www.videolan.org/vlc/

mpv (CLI)

→ mpv.io

ffplay (CLI)

→ ffmpeg.org

9

Grafische Benutzeroberfläche

FFCommand Engine (GUI)

→ github.com/ColorlabMD/FFCommand_Engine

10



11

Einzelbild und Stream

RAWcooked (CLI)

→ mediaarea.net/RAWcooked

12

RAWcooked

- encoding into Matroska (.mkv) using FFV1 video codec and FLAC audio codec
- all metadata preserved
- decoding with bit-by-bit reversibility
- possibility to embed sidecar files, for example MD5, LUT, XML, PDF
- compatibility with media players

13

Übungen

14

Einstieg

15

Arbeitsfolder setzen

Linux/Mac/Windows Terminal oder WSL:

```
cd ~/Desktop
```

Windows lokal:

```
cd Desktop
```

Windows auf OneDrive Cloud:

```
cd OneDrive
```

16

Befehlsstruktur

\$0 **\$1** **\${n}**
command argument_1 ... argument_n

Beispiele üblicher Syntaxen der Argumenten:

--parameter
--parameter=value
-p
-p value

17

Bilddatei erzeugen

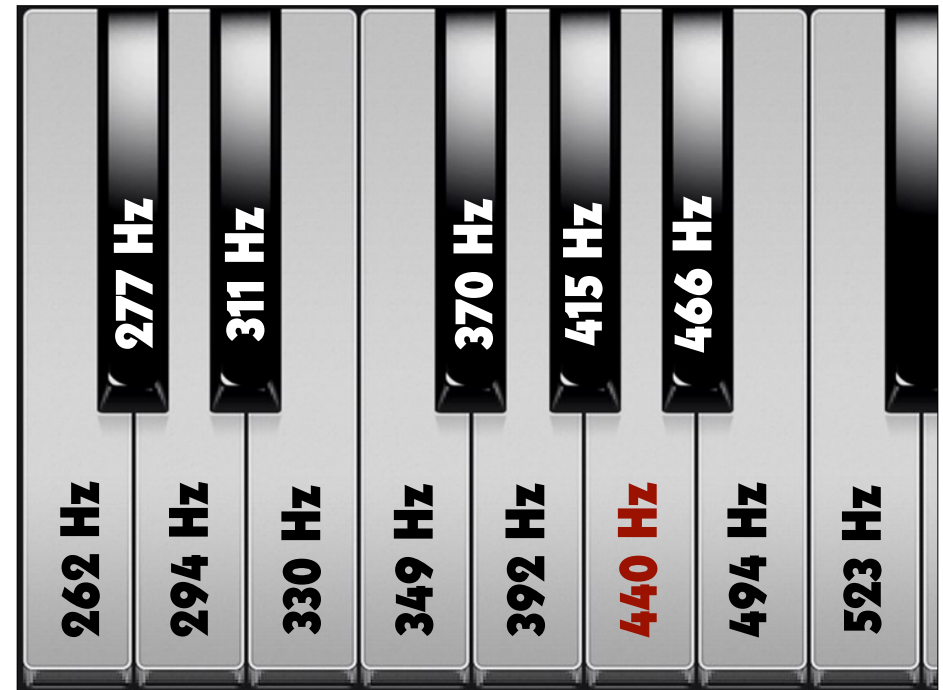
```
ffmpeg  
-lavfi mandelbrot  
-t 10  
-c:v rawvideo  
-pix_fmt uyvy422  
mandelbrot.avi
```

18

Bilddatei abspielen

```
ffplay  
mandelbrot.avi
```

19



20

Tondatei erzeugen

```
ffmpeg  
-lavfi sine=frequency=440  
-c:a pcm_s16le  
-ar 48k  
-ac 2  
-t 10  
la.wav
```

21

Tondatei abspielen

```
ffplay  
la.wav
```

22

Dateien zusammenfügen

```
ffmpeg  
-i mandelbrot.avi  
-i la.wav  
-c:v copy  
-c:a copy  
mandela.avi
```

23

AV-Datei abspielen

```
ffplay  
mandela.avi
```

24

Metadaten extrahieren (1)

```
ffprobe  
  mandela.avi
```

25

Container und Codec

```
ffprobe  
-show_format  
-show_streams  
  mandela.avi
```

26

Metadaten formatieren

```
ffprobe  
-show_format  
-show_streams  
-print_format json  
  mandela.avi
```

27

Metadaten speichern

```
ffprobe  
-show_format  
-show_streams  
-print_format json  
  mandela.avi  
> mandela.txt
```

28

Metadaten extrahieren (2)

```
mediainfo  
  mandela.avi
```

29

Hilfe finden

```
ffmpeg -h  
ffmpeg -codecs  
ffmpeg -decoders  
ffmpeg -h decoder=aac  
ffmpeg -encoders  
ffmpeg -h encoder=libx264  
ffmpeg -filters  
ffmpeg -pix_fmts
```

30

Umwandlungen

31

Container ändern

```
ffmpeg  
  -i mandelbrot.avi  
  -c copy  
  mandelbrot.mov
```

32

MD5-Prüfsummen (1)

ffmpeg

-i *mandelbrot.avi*

-f **framemd5**

mandelbrot_avi_framemd5.txt

33

MD5-Prüfsummen (2)

ffmpeg

-i *mandelbrot.mov*

-f **framemd5**

mandelbrot_mov_framemd5.txt

34

Prüfsummen vergleichen

Linux/Mac/Windows Terminal oder WSL:

diff -s

mandelbrot_avi_framemd5.txt

mandelbrot_mov_framemd5.txt

Windows:

fc

mandelbrot_avi_framemd5.txt

mandelbrot_mov_framemd5.txt

35

Archivalltag

36

Einzelbilder abspielen

ffplay

-loop 0

DUFAY_TIFF/Dufay_%06d.tif

37

Dateiumwandlungen

- von Master- nach Mezzanine- und von Mezzanine- nach Zugangsdatei
- von Master- nach Zugangsdatei

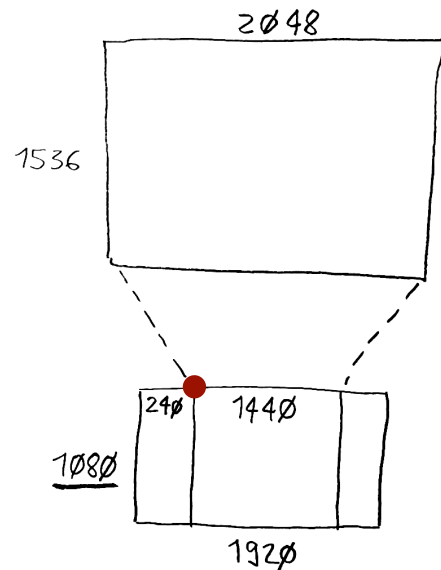
- Vergleiche die Qualität der Zugangsdateien
- Vergleiche die Qualität der Mezzaninedateien (Apple ProRes und AVID).

38

2K
4:3



HD
16:9

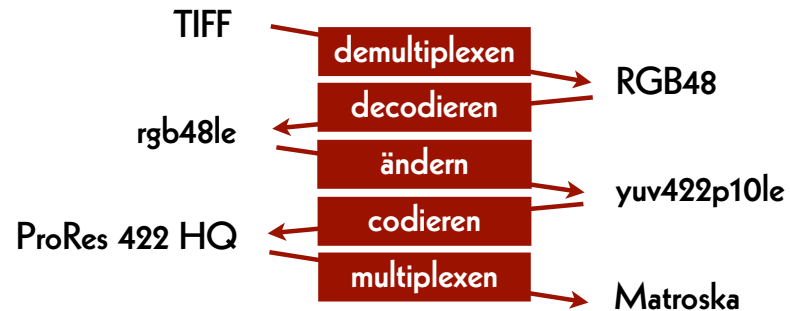


39

ProRes

40

Von TIFF nach ProRes



41

ProRes 422 und ProRes 4444

- QuickTime (.mov)
- Matroska (.mkv)
- MXF = Material eXchange Format (.mxf)

42

Master → Mezzanine (1)

ffmpeg

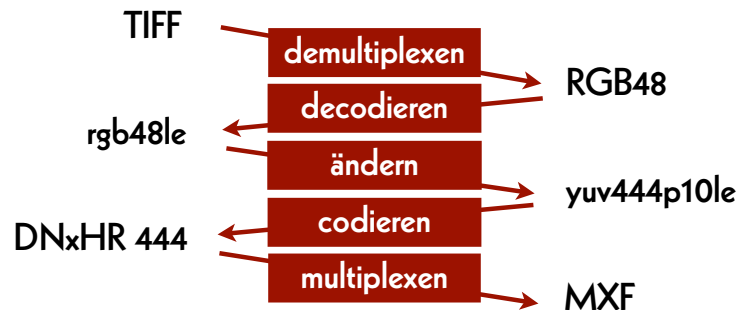
```
-f image2 -framerate 24  
-i DUFAY_TIFF/Dufay_%06d.tif  
-filter:v  
  "scale=1440:1080:flags=lanczos,  
  pad=1920:1080:240:0"  
-c:v prores_ks -profile:v 3  
Dufay_ProRes.mkv
```

43

AVID

44

Von TIFF nach DNxHR



45

Die Parameters finden

```
ffmpeg -h encoder=dnxhd
```

```
-profile:v dnxhr_lb -pix_fmt yuv422p  
-profile:v dnxhr_sq -pix_fmt yuv422p  
-profile:v dnxhr_hq -pix_fmt yuv422p  
-profile:v dnxhr_hqx -pix_fmt yuv422p10le  
-profile:v dnxhr_444 -pix_fmt yuv444p10le  
-profile:v dnxhr_444 -pix_fmt gbrp10le
```

46

Master -> Mezzanine (2)

```
ffmpeg
```

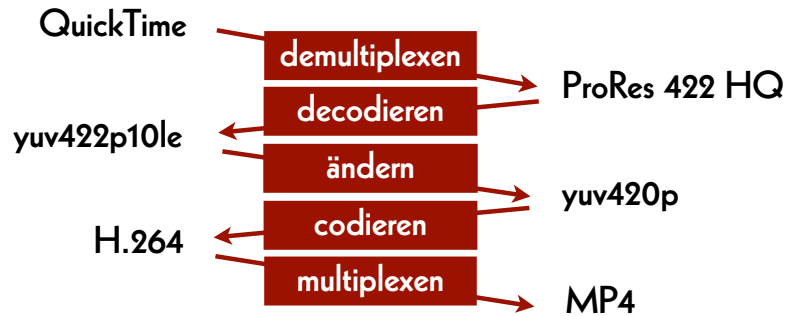
```
-f image2 -framerate 24  
-i DUFAY_TIFF/Dufay_%06d.tif  
-filter:v  
  "scale=1440:1080:flags=lanczos,  
  pad=1920:1080:240:0"  
-c:v dnxhd -profile:v dnxhr_444  
-pix_fmt yuv444p10le  
Dufay_DNxHR.mxf
```

47

H.264

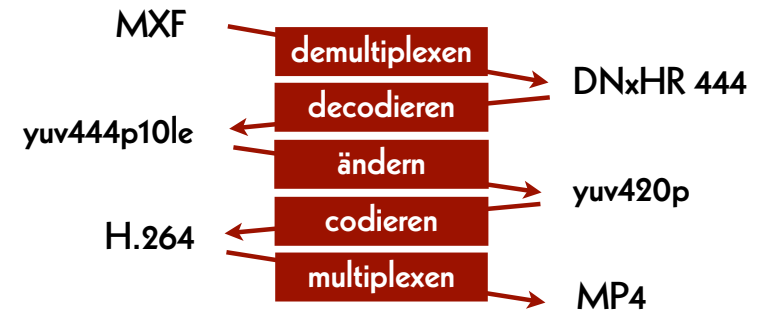
48

Von ProRes nach H.264



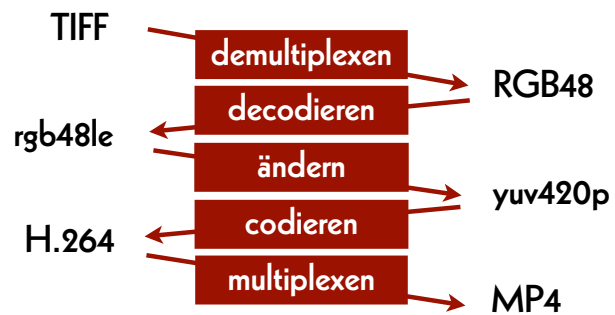
49

Von DNxHR nach H.264



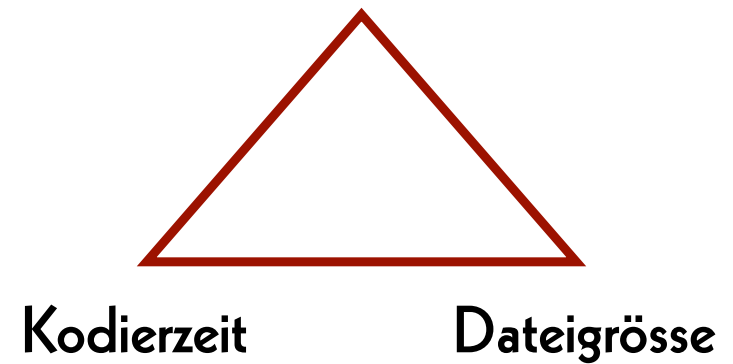
50

Von TIFF nach H.264



51

Bildqualität



52

Mezzanine -> Zugang (1)

```
ffmpeg
-i Dufay_ProRes.mkv
-pix_fmt yuv420p
-c:v libx264 -preset veryslow -crf 30
-movflags +faststart
Dufay_ProRes_H264.mp4
```

53

Mezzanine -> Zugang (2)

```
ffmpeg
-i Dufay_DNxHR.mxf
-pix_fmt yuv420p
-c:v libx264 -preset veryslow -crf 30
-movflags +faststart
Dufay_DNxHR_H264.mp4
```

54

Master -> Zugang

```
ffmpeg
-f image2 -framerate 24
-i DUFAY_TIFF/Dufay_%06d.tif
-filter:v
"scale=1440:1080:flags=lanczos,
pad=1920:1080:240:0"
-pix_fmt yuv420p
-c:v libx264 -preset veryslow -crf 30
-movflags +faststart
Dufay_master_H264.mp4
```

55

Qualitätskontrolle

- Differenzdatei zweier Dateien
- geteilter Bildschirm aus zwei Dateien

56

Geteilter Bildschirm (1)

ffmpeg

```
-i Dufay_master_H264.mp4  
-i Dufay_ProRes_H264.mp4  
-filter_complex  
  "[0]crop=iw/2:ih:0:0[left];  
  [1]crop=iw/2:ih:iw/2:0[right];  
  [links][rechts]hstack"  
Dufay_split_ProRes.mp4
```

57

Geteilter Bildschirm (2)

ffmpeg

```
-i Dufay_master_H264.mp4  
-i Dufay_DNxHR_H264.mp4  
-filter_complex  
  "[0]crop=iw/2:ih:0:0[left];  
  [1]crop=iw/2:ih:iw/2:0[right];  
  [left][right]hstack"  
Dufay_split_DNxHR.mp4
```

58

Geteilter Bildschirm (3)

ffmpeg

```
-i Dufay_ProRes_H264.mp4  
-i Dufay_DNxHR_H264.mp4  
-filter_complex  
  "[0]crop=iw/2:ih:0:0[left];  
  [1]crop=iw/2:ih:iw/2:0[right];  
  [left][right]hstack"  
Dufay_split_mezzanine.mp4
```

59

Filter testen

ffplay

```
-vf "negate"  
Dufay_1_H264.mp4
```

60

Differenzdatei (1)

ffmpeg

```
-i Dufay_master_H264.mp4
-i Dufay_ProRes_H264.mp4
-filter_complex
  "[1]format=yuva444p,
  lut=c3=128,
  negate[1_with_alpha];
  [0][1_with_alpha]overlay"
Dufay_delta_ProRes.mp4
```

61

Differenzdatei (2)

ffmpeg

```
-i Dufay_master_H264.mp4
-i Dufay_DNxHR_H264.mp4
-filter_complex
  "[1]format=yuva444p,
  lut=c3=128,
  negate[1_with_alpha];
  [0][1_with_alpha]overlay"
Dufay_delta_DNxHR.mp4
```

62

Differenzdatei (3)

ffmpeg

```
-i Dufay_ProRes_H264.mp4
-i Dufay_DNxHR_H264.mp4
-filter_complex
  "[1]format=yuva444p,
  lut=c3=128,
  negate[1_with_alpha];
  [0][1_with_alpha]overlay"
Dufay_delta_mezzanine.mp4
```

63

AV Preservation by
reto.ch

zone industrielle Le Trési 3
1028 Préverenges
Switzerland

Web: reto.ch
Twitter: @retoch
Email: info@reto.ch



64