

FFmpeg-Workshop

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Benutzerschnittstellen

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

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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

Changed or added in 1963 version
 Changed in both 1963 version and 1965 draft

source: wikipedia.org

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Unix/Linux-Befehlsstruktur

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

Beispiele üblicher Syntaxen der Argumenten:

--parameter

--parameter=value

-p

-p value

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Software

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FFmpeg wird überall eingesetzt

- VLC und mpv
- Audacity und Handbrake
- QCTools und AEO-Light
- vrecord
- Google Chrome und YouTube
- «et cetera et cetera et cetera»

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Die FFmpeg-Familie

Programme

- ffmpeg
- ffprobe
- ffplay

Bibliotheken

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

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Dateiumwandlungen

ffmpeg (CLI)

→ ffmpeg.org

FFmpeg Cookbook for Archivists

→ avpres.net/FFmpeg/

ffmprovisr

→ amiaopensource.github.io/ffmprovisr/

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Metadaten extrahieren

MediaInfo (GUI, CLI)

→ mediaarea.net/MediaInfo

ffprobe (CLI)

→ ffmpeg.org

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Mediaplayer

VLC (GUI)

→ www.videolan.org/vlc/

mpv (CLI/GUI)

→ mpv.io

ffplay (CLI)

→ ffmpeg.org

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Grafische Benutzeroberfläche

FFCommand Engine (GUI)

→ github.com/ColorlabMD/FFCommand_Engine

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FFmpeg-Befehlsstruktur

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

FFmpeg-Syntax der Argumenten:

-parameter
-parameter value
-p
-p value

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FFmpeg Syntax

ffmpeg
[*global_options*]
[*input_options_n*] **-i** *input_file_n*
[*output_options_n*] *output_file_n*

ffprobe [*input_options*] *input_file*

ffplay [*input_options*] *input_file*

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Programmbibliotheken

demultiplexen: libavformat
decodieren: libavcodec
ändern: libavfilter
codieren: libavcodec
multiplexen: libavformat

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Übungen

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Arbeitsfolder setzen

```
# Linux
# Mac
# Windows Terminal oder WSL
# Windows lokal
cd Desktop

# Windows auf OneDrive Cloud
cd OneDrive
```

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Bilddatei erzeugen

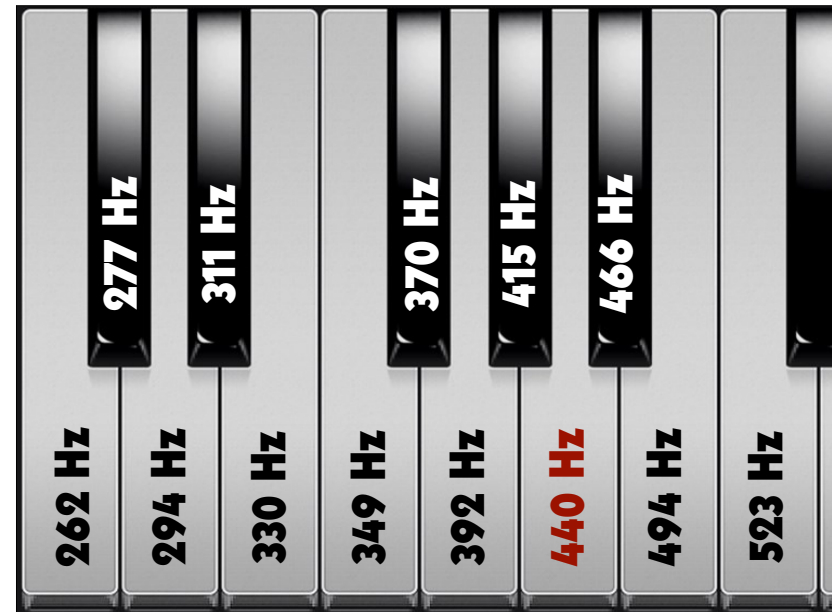
```
ffmpeg
-f lavfi -i mandelbrot
-t 10
-c:v rawvideo
-pix_fmt uyvy422
mandelbrot.avi
```

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Bilddatei abspielen

```
ffplay
mandelbrot.avi
```

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Tondatei erzeugen

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

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Tondatei abspielen

```
ffplay  
La.wav
```

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Dateien zusammenfügen

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

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AV-Datei abspielen

```
ffplay  
mandela.avi
```

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Metadaten extrahieren (1)

```
ffprobe  
mandela.avi
```

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Container

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

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Codec

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

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Container und Codec

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

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Metadaten formatieren

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

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Metadaten speichern

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

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Textdatei im Terminal

```
# Linux/Mac/Windows Terminal oder WSL
cat
  mandela.txt

# Windows
dir
  mandela.txt
```

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Metadaten extrahieren (2)

```
mediainfo
  mandela.avi
```

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Hilfe finden

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

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Dateiumwandlungen

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Container ändern

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

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MD5-Prüfsummen (1)

```
ffmpeg  
-i mandelbrot.avi  
-f framemd5  
mandelbrot.avi_framemd5.txt
```

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MD5-Prüfsummen (2)

ffmpeg

-i mandelbrot.mov

-f framemd5

mandelbrot_mov_framemd5.txt

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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

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Einzelbilder abspielen

ffplay

-loop 0

DUFAY_TIFF/Dufay_#06d.tif

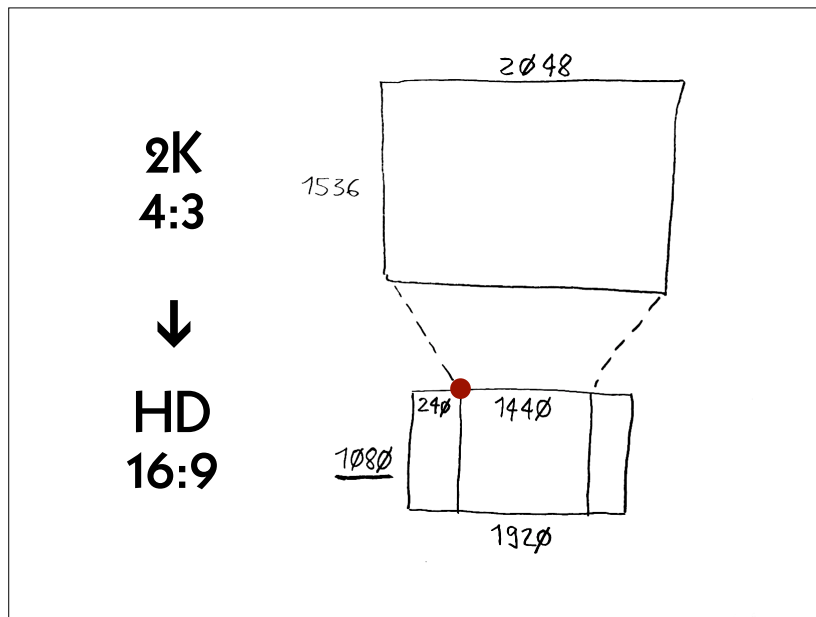
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Dateiumwandlungen

- 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).

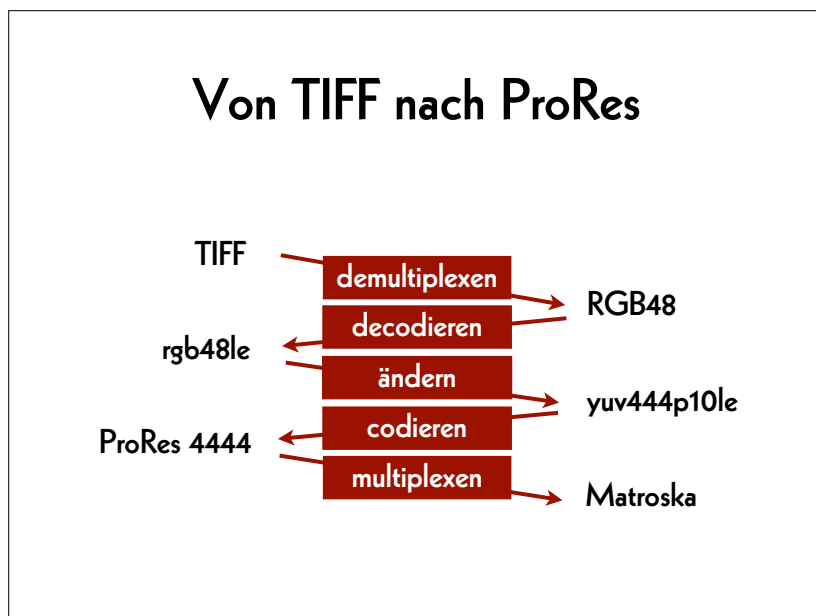
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ProRes

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ProRes 422 und ProRes 4444

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

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Master -> Mezzanine (1)

ffmpeg

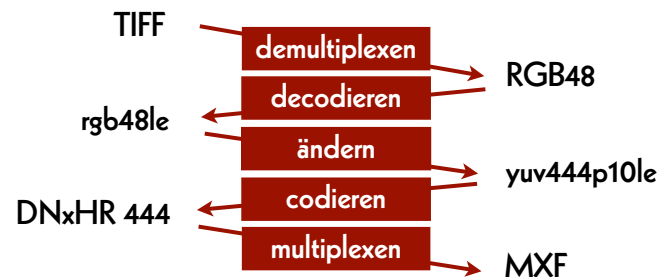
```
-f image2 -framerate 24  
-i DUFAY_TIFF/Dufay_%06d.tif  
-filter:v  
  "scale=1440:1080:flags=lanczos,  
  pad=1920:1080:240:0"  
-c:v prores_ks -profile:v 4  
Dufay_ProRes.mkv
```

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AVID

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Von TIFF nach DNxHR



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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
```

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Master -> Mezzanine (2)

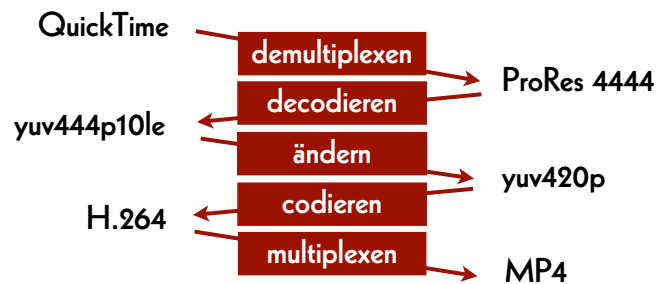
```
ffmpeg
-f image2 -framerate 24
-i DUFAY_TIFF/Dufay_%06d.tif
-filter:v
  "scale=1440:1080:flags=lanczos,
  pad=1920:1080:240:0"
-c:v dnxhd -profile:v dnxhr_444
-pix_fmt yuv444p10le
Dufay_DNxHR.mxf
```

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H.264

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Von ProRes nach H.264



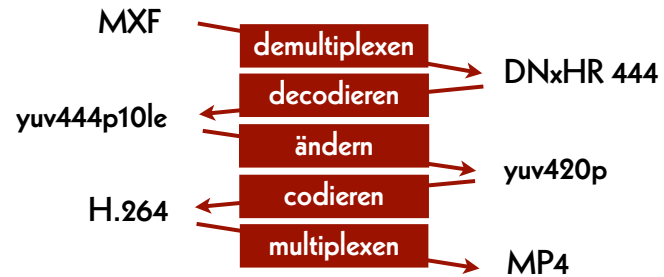
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Mezzanine -> Zugang (1)

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

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Von DNxHR nach H.264



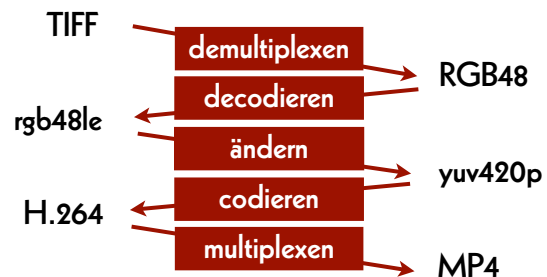
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Mezzanine -> Zugang (2)

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

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Von TIFF nach H.264



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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"  
-c:v libx264 -preset veryslow -crf 30  
-pix_fmt yuv420p  
-movflags +faststart  
Dufay_master_H264.mp4
```

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Qualitätskontrolle

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Workflow

define accepted file formats

perform quality control

- checksum
- filename
- container, codec and data formats
- image and sound content

prepare archive package

store packages (e.g. onto LTO tapes)

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Qualitätskontrolle

- check technical metadata
- analyse signal
- watch image and listen sound

- Differenzdatei zweier Dateien
- geteilter Bildschirm aus zwei Dateien

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Quality Control Tools

container and codec

- MedialInfo, ffprobe, MediaConch
- hexdump, fq

image and sound content

- QCTools, qcli, SignalServer
- VLC, mpv, ffmpeg

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Archival Tools

- RAWcooked
- Baglt

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Geteilter Bildschirm (1)

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

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Geteilter Bildschirm (2)

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

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Geteilter Bildschirm (3)

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

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Filter testen

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

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Differenzdatei (1)

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

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Differenzdatei (2)

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

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Differenzdatei (3)

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

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Generate a Sound File

```
ffmpeg
-f lavfi -i "anoisesrc=color=brown"
-filter:a "tremolo=f=0.1:d=0.9"
-c:a pcm_s24le
-ar 96k
-ac 2
-t 60
seashore_good.wav
```

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Play the File

```
ffplay
seashore_good.wav
```

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Damage the Sound File

```
ffmpeg
-i seashore_good.wav
-c copy
-bsf:a "noise=amount=-1"
seashore_bad.wav
```

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Play the Damaged File

```
ffplay
seashore_bad.wav
```

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Show Volume (good)

```
ffplay
-f lavfi "amovie=seashore_good.wav,
asplit [a][out1];
[a] showvolume=c=VOLUME:
w=1000:h=100:
ds=lin [out0]"
```

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Show Volume (bad)

```
ffplay
-f lavfi "amovie=seashore_bad.wav,
asplit [a][out1];
[a] showvolume=c=VOLUME:
w=1000:h=100:
ds=lin [out0]"
```

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Show Waves (good)

```
ffplay
-f lavfi "amovie=seashore_good.wav,
asplit [a][out1];
[a] showwaves=mode=cline [out0]"
```

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Show Waves (bad)

```
ffplay
-f lavfi "amovie=seashore_bad.wav,
asplit [a][out1];
[a] showwaves=mode=cline [out0]"
```

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Show Spectrum (good)

```
ffplay  
-f lavfi "amovie=seashore_good.wav,  
asplit [a][out1];  
[a] showspectrum=mode=separate:  
color=intensity:  
slide=1:  
scale=cbrt [out0]"
```

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Show Spectrum (bad)

```
ffplay  
-f lavfi "amovie=seashore_bad.wav,  
asplit [a][out1];  
[a] showspectrum=mode=separate:  
color=intensity:  
slide=1:  
scale=cbrt [out0]"
```

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Personalisieren

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Schriftarten finden

```
# Linux/Mac/Windows Terminal oder WSL  
ls /Library/Fonts  
  
# Windows  
dir \Windows\Fonts
```

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Wasserzeichen hinzufügen

```
ffmpeg
-i Dufay_master_H264.mp4
-filter:v
  "drawtext=text='watermark':
  fontfile='/Library/Fonts/Arial.ttf':
  fontsize=35:
  fontcolor=white:
  alpha=0.25:
  x=(w-text_w)/2:y=(h-text_h)/2"
watermark.mp4
```

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Timecode hinzufügen

```
ffmpeg
-i Dufay_master_H264.mp4
-filter:v
  "drawtext=timecode='01\:00\:30\:00':
  rate=25:
  fontfile='/Library/Fonts/Arial.ttf':
  fontsize=35:
  fontcolor=white:
  x=(w-text_w)/2:y=h/1.2"
timecode.mp4
```

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Logo hinzufügen

```
ffmpeg
-i Dufay_master_H264.mp4
-i Logo.png
-filter_complex
  "overlay=10:main_h-overlay_h-10"
mit_Logo.mp4
```

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