

An Introduction to FFmpeg

Reto Kromer • AV Preservation by reto.ch

Open-Source Tools and Resources for Audio-Visual Archives

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Interacting with the computer

- command-line interface (CLI)
- graphical user interface (GUI)

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The FFmpeg Family

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Components

Tools

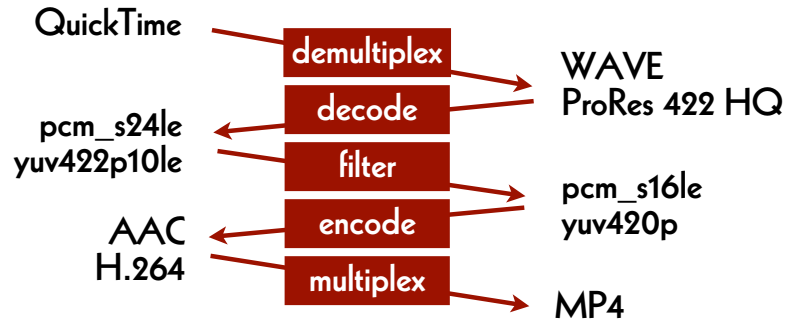
- ffmpeg
- ffplay
- ffprobe

Libraries

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

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Audio-Visual Exemple



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Data Transformations



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File Transformations

ffmpeg (CLI)

→ ffmpeg.org

FFmpeg Cookbook for Archivists

→ avpres.net/FFmpeg/

ffmprovisr

→ amiaopensource.github.io/ffmprovisr/

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Metadata Extraction

MediaInfo (GUI, CLI)

→ mediaarea.net/MediaInfo

ffprobe (CLI)

→ ffmpeg.org

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Media Player

VLC (GUI)

→ www.videolan.org/vlc/

mpv (CLI)

→ mpv.io

ffplay (CLI)

→ ffmpeg.org

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A GUI for FFmpeg

FFCommand Engine (GUI)

→ github.com/ColorlabMD/FFCommand_Engine

version 0.6 for macOS via Homebrew:

```
brew tap avpres/formulae
```

```
brew install --HEAD ffcommand-engine
```

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	avantages	disavantages
TIFF DPX OpenEXR	data easier to process	bigger files
JPEG 2000 FFV1	smaller files	data complexer to process

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Single Images and Streams

RAWcooked (CLI)

→ mediaarea.net/RAWcooked

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Exercises

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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

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Basics

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Set the Working Space

Linux/Mac:

```
cd ~/Desktop
```

Windows:

```
cd Desktop
```

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Generate an Image File

```
ffmpeg
```

```
-lavfi mandelbrot
```

```
-t 10
```

```
-c:v rawvideo
```

```
-pix_fmt uyvy422
```

```
mandelbrot.avi
```

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Play the Image File

```
ffplay
```

```
mandelbrot.avi
```

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Generate a Sound File

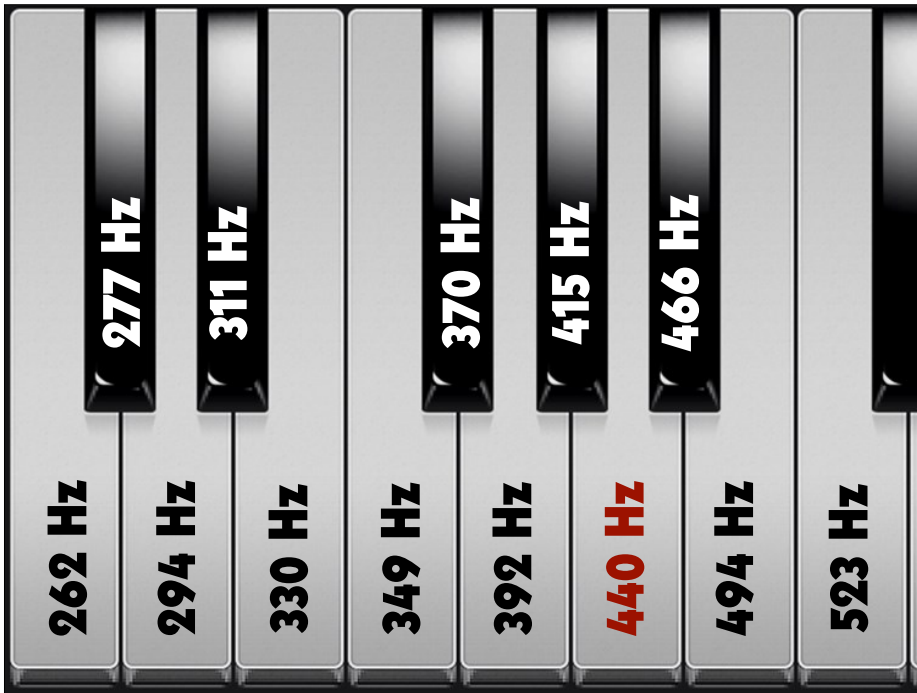
```
ffmpeg
```

```
-lavfi sine=frequency=440
```

```
-t 10
```

```
la.wav
```

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Merge Image and Sound

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

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Play the Sound File

```
ffplay  
la.wav
```

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Play the AV File

```
ffplay  
mandela.avi
```

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Extract the Metadata

```
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 and Codec

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

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Format the Output

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

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Save the Metadata

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

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Find Help

```
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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Transformations

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Modify the Container

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

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MD5 Checksums (1)

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

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MD5 Checksums (2)

```
ffmpeg  
-i mandelbrot.mov  
-f framemd5  
mandelbrot.mov_framemd5.txt
```

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Compare the Checksums

Linux/Mac:

```
diff -s  
mandelbrot.avi_framemd5.txt  
mandelbrot.mov_framemd5.txt
```

Windows:

```
fc  
mandelbrot.avi_framemd5.txt  
mandelbrot.mov_framemd5.txt
```

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Master to Access

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Play Single Images

ffplay

-loop 0

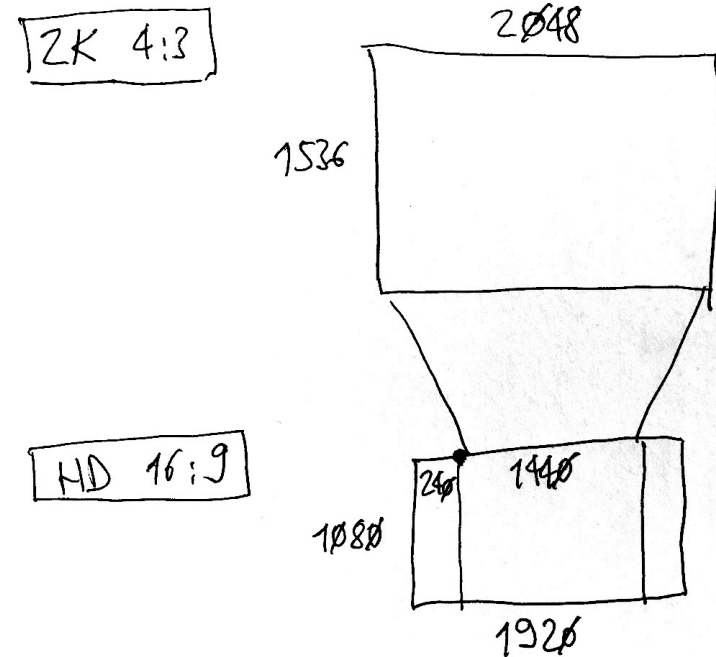
DUFAY_TIFF/Dufay_%06d.tif

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File Transformations

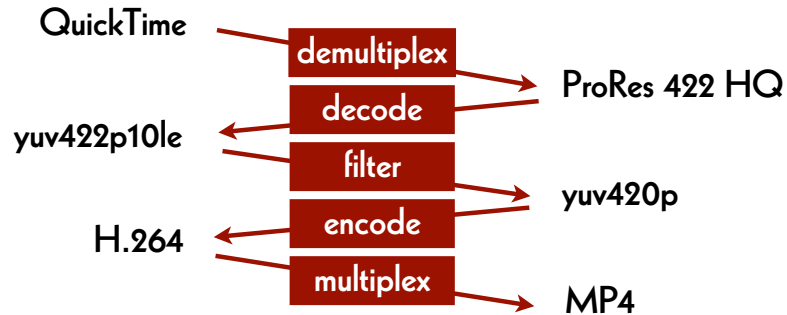
- from the master file to a mezzanine file
- from the master file to an access file
- from the mezzanine file to an access file

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Video Exemple



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Is the Quality the Same?

master file → mezzanine file → access file
master file → access file

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Master → Mezzanine

```
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
```

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ProRes 422 and ProRes 4444

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

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Master -> Access

```
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
Dufay_1_H264.mp4
```

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Mezzanine -> Access

```
ffmpeg
-i Dufay_ProRes.mkv
-pix_fmt yuv420p
-c:v libx264 -preset veryslow -crf 30
Dufay_2_H264.mp4
```

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Quality control

- difference file
- split screen

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Split screen

```
ffmpeg
-i Dufay_1_H264.mp4
-i Dufay_2_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_H264_split.mp4
```

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Difference file

ffmpeg

-i *Dufay_1_H264.mp4*

-i *Dufay_2_H264.mp4*

-filter_complex

"[1]format=yuva444p,

lut=c3=128,

negate[1_with_alpha];

[0][1_with_alpha]overlay"

Dufay_H264_delta.mp4

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