

Tour de Chateau

Automated filtering of
Tour de France footage
with Linux

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2013-08-31

Tour des Châteaux

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Tour des Châteaux Torres de Castellos

Automated filtering of
Tour de France and
Vuelta a España
footage with Linux

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2013-09-08

Tour de France

A multiple stage bicycle race primarily held in France, while also occasionally making passes through nearby countries. First organized in 1903 to increase paper sales for the magazine L'Auto, it has been held annually since its first edition in 1903 except for two World Wars. As the Tour gained popularity it has lengthened to 21 days and its reach has extended around the globe. Participation has expanded from a primarily French field, as riders from all over the world began to take part.

(thanks wikipedia)

Vuelta a España

An annual multiple stage bicycle race primarily held in Spain, while also occasionally making passes through nearby countries. Inspired by the success of the Giro d'Italia and the Tour de France, the race was first organized in 1935. The race was prevented from being run by the Spanish Civil War and World War II in the early years of its existence; however, the race has been held annually since 1955.

(thanks wikipedia)

Televising Tour de France

French broadcasters France 2 and 3 organise the Tour broadcast with equipment including:

- a staff of 300
- three helicopters
- two aircraft
- five motorcycles
- 35 other vehicles and trucks (edit suite, comms)
- 20 fixed cameras
- local Australian DVB broadcast by SBS television

Televising Vuelta a España

Sadly, Wikipedia has next to no information on this, but we presume very similar requirements:

- two camera helicopters
- one aircraft for radio/comms
- three camera motorcycles
- local Australian DVB broadcast by SBS television

So far so good, but ...

- Each Tour de France live broadcast typically 4 hours
- I'm not amazingly interested in road cycling
- Too many shots of sweaty fit men on bicycles
- Usually good commentary, but often inane
- Whilst there are scenery shots, difficult to find
- On holiday, missed several days, hard to catch up
- 4 hour DVB SD files are 5.9GB, HD files 17GB (!)
- Vuelta is easier – limited live SBS broadcast ... :(

Bad



Good



Bad



Good



Terrible



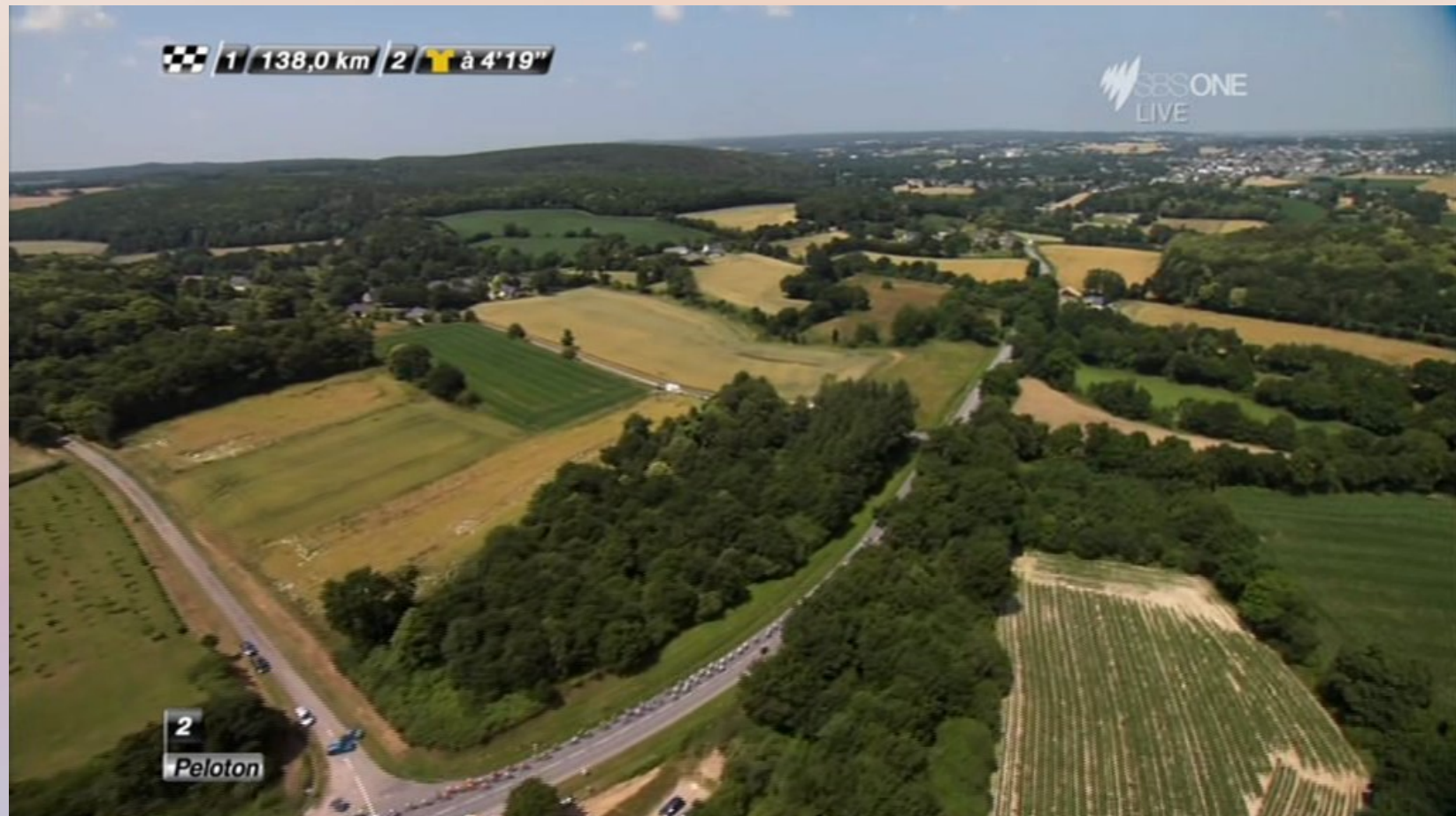
Good



Bad



Good



Bad



Good



Terrible



Bad



Good



Bad



Good



Terrible



Good



Bad



Bad



Good



Terrible



The advertisement features a glowing blue brain on the left and a white bottle of Swisse Memory + Focus supplement on the right. A dashed white line separates the brain from the text below it. The text reads: > SUPPORTS BLOOD FLOW TO THE BRAIN. The bottle label includes the following text: Swisse, MEMORY + FOCUS, GINKGO & BRAHMI, HEALTHY BRAIN FUNCTION, ENERGY RELEASE & STRESS SUPPORT, 50 TABLETS, and AUST L 19171.

> SUPPORTS
BLOOD FLOW TO
THE BRAIN

Swisse
**MEMORY
+ FOCUS**
GINKGO & BRAHMI
HEALTHY BRAIN FUNCTION
ENERGY RELEASE &
STRESS SUPPORT
50 TABLETS
AUST L 19171

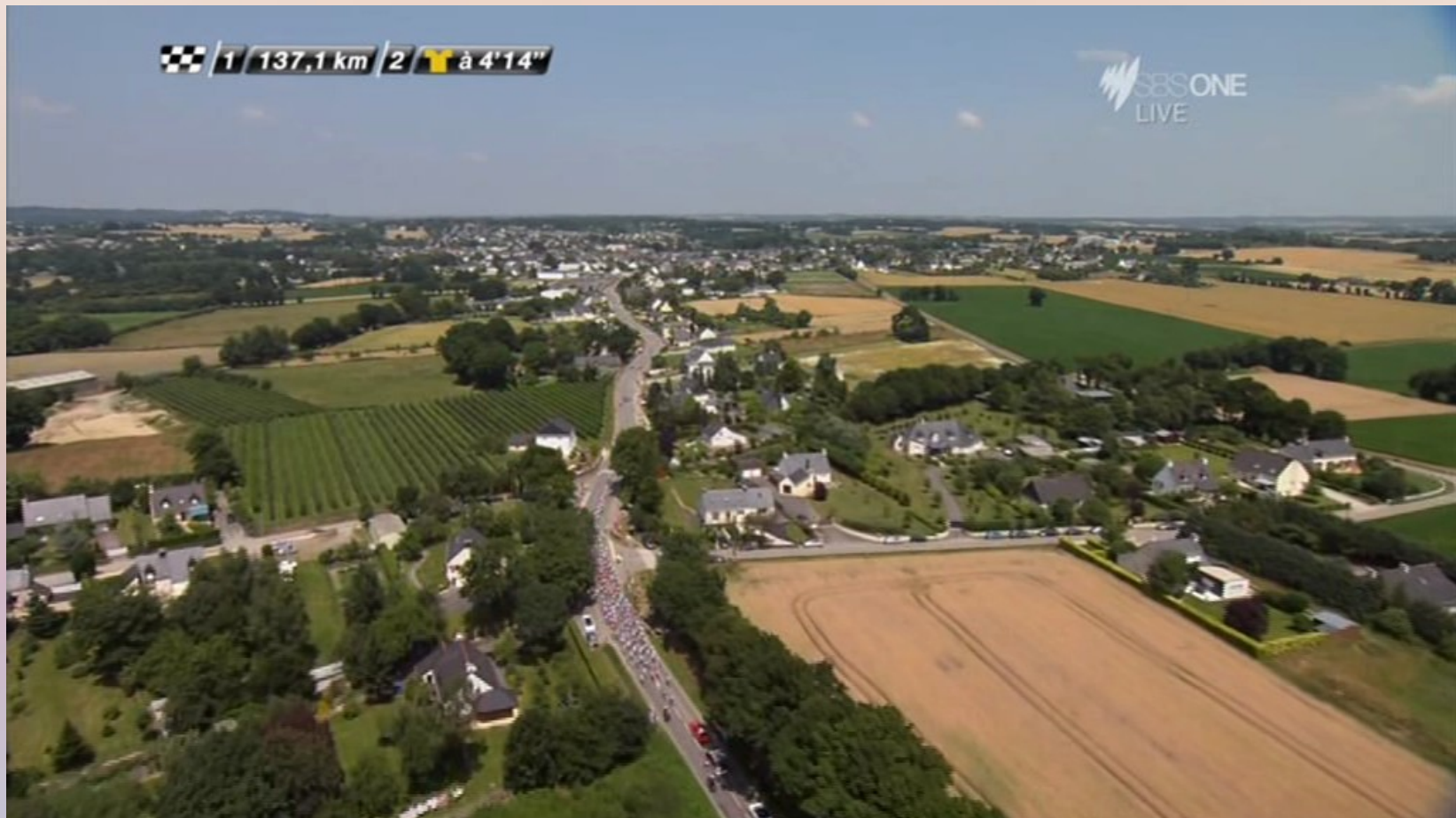
Good



Bad



Good



Bad



Good



Terrible



WIN

**A TOUR DE FRANCE 2014
VIP EXPERIENCE FOR 2**

Entry is open to Australian residents aged 18 and over only. Competition commences on 01/07/13 at 09:00am AEST and concludes on 29/08/13 at 11:59pm AEST. Winner will be drawn at SBS in Artarmon on 09/09/13 at 10:30am AEST and published in The Australian on 08/09/13. For full prize details, terms and conditions and how to enter go to sbs.com.au/win. NSW PERMIT NO. LTPS/13-00244, VIC PERMIT NO. 13/1105, ACT PERMIT NO. TP130187, SA PERMIT NO. 713/924.

Good



Bad



Good



Bad



Good



Terrible



Good



Bad



Good



Bad



Good



Terrible

FROM **\$15,990*** DRIVE
AWAY



*Drive away price for a SKODA Fabia manual 63MPi limited edition (no added options) available at participating SKODA dealers on stock vehicles ordered and delivered between June 1, 2013 and August 31, 2013. While stocks last. Excludes fleet, government and rental buyers. Not available with any other offer.

Good



Bad



MIKE TOMALARIS
Host

Good



Bad



Good



Terrible

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Good



Good



Good



Good



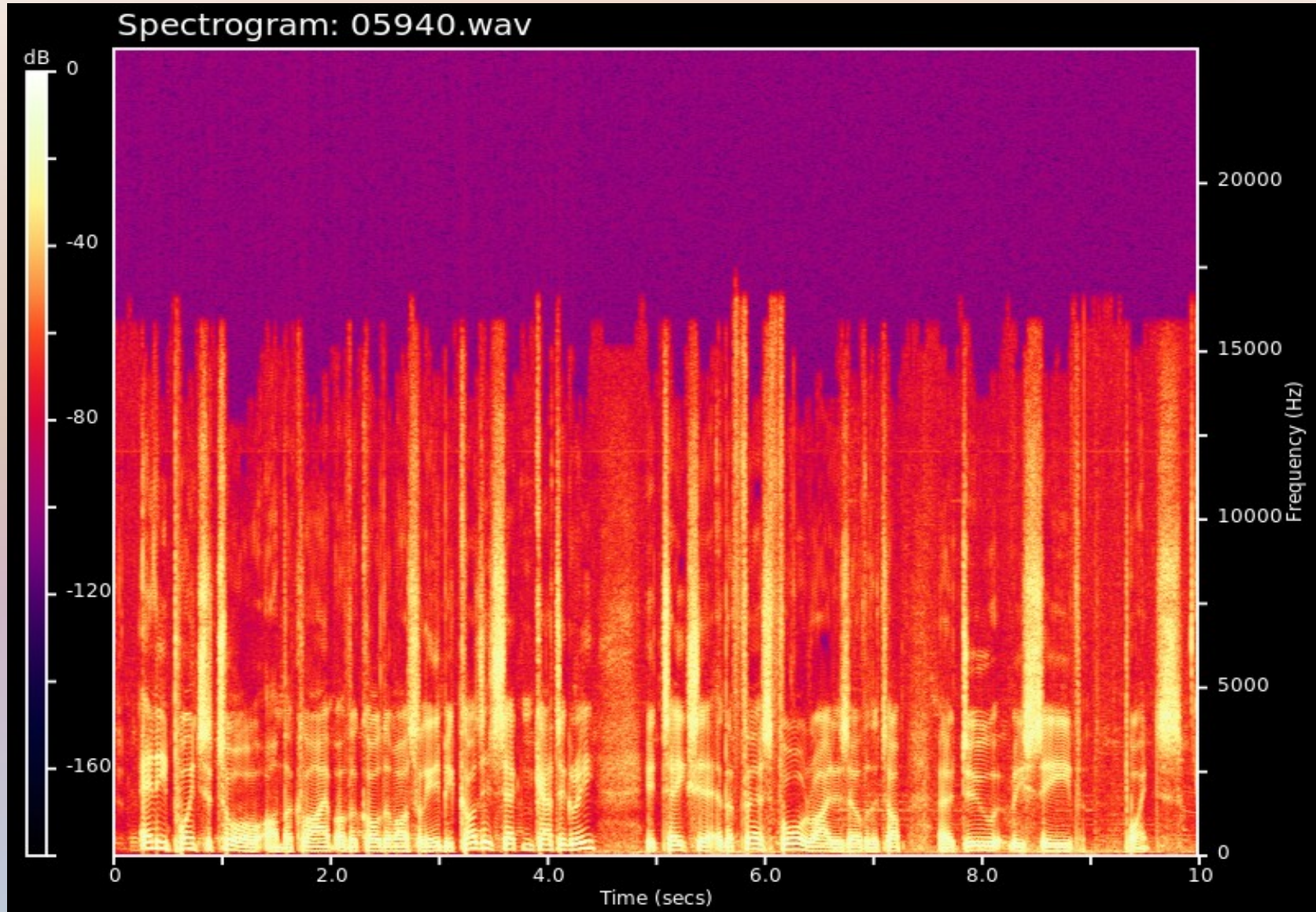
So - helicopter shots

- Most interesting shots of scenery or buildings are from the helicopter-mounted cameras
- Broadcast audio tends to have helicopter sound mixed in to a certain extent
- Engine turbine clearly audible during shots
- External shots do not feature tone, from cabin only
- Audio is much, much easier to process than video

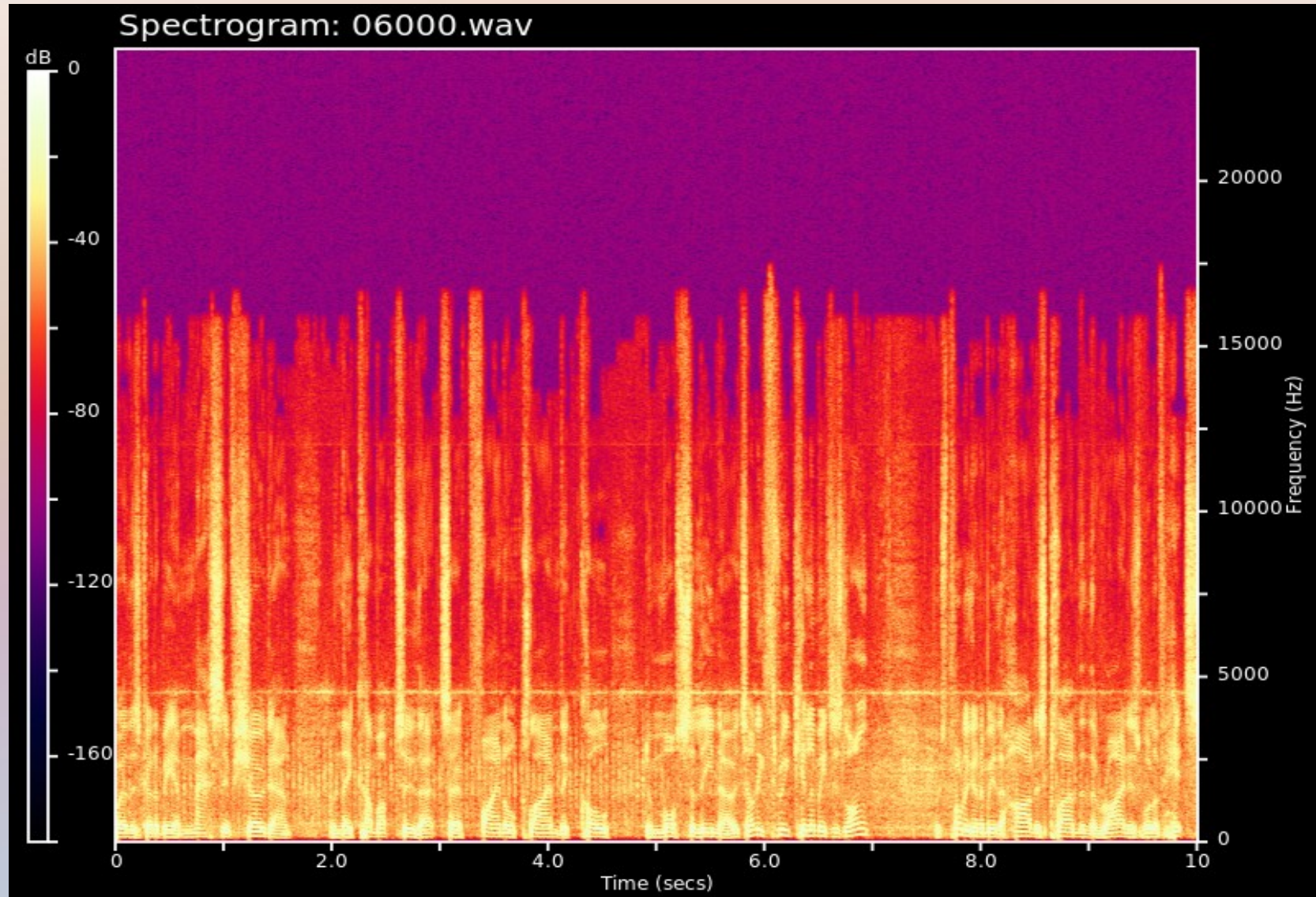
Fast Fourier Transforms 101

- Digital Systems tool to convert time-domain signal into frequency-domain signal
- Used to be processor intensive, now not so much
- Many different tools available
- Chose to use sndfile-spectrogram due to simplicity
- Takes WAV input, outputs PNG
- Ultimately want to use python's numpy to do this bit, but not gotten there yet

“Boring” shot FFT



“Interesting” shot FFT



Prototype processing method

- mplayer to play/dump audio from DVB MPEG TS
- mp3splt to chop into small chunks
- mpg123 to convert each to PCM
- sndfile-spectrogram to convert to PNG
- netpbm suite to isolate tone
- perl script glue to create edit decision list
- mencoder to convert MPEG to Xvid with EDL

Image processing

- Use image processing tools to enhance tone line
- Convert to grey scale
- Normalise to reduce noise floor
- Convolute with mask to identify shape
- Crop to isolate area of interest
- Sort histogram of pixels for simple shell script based determination

Convolution 101

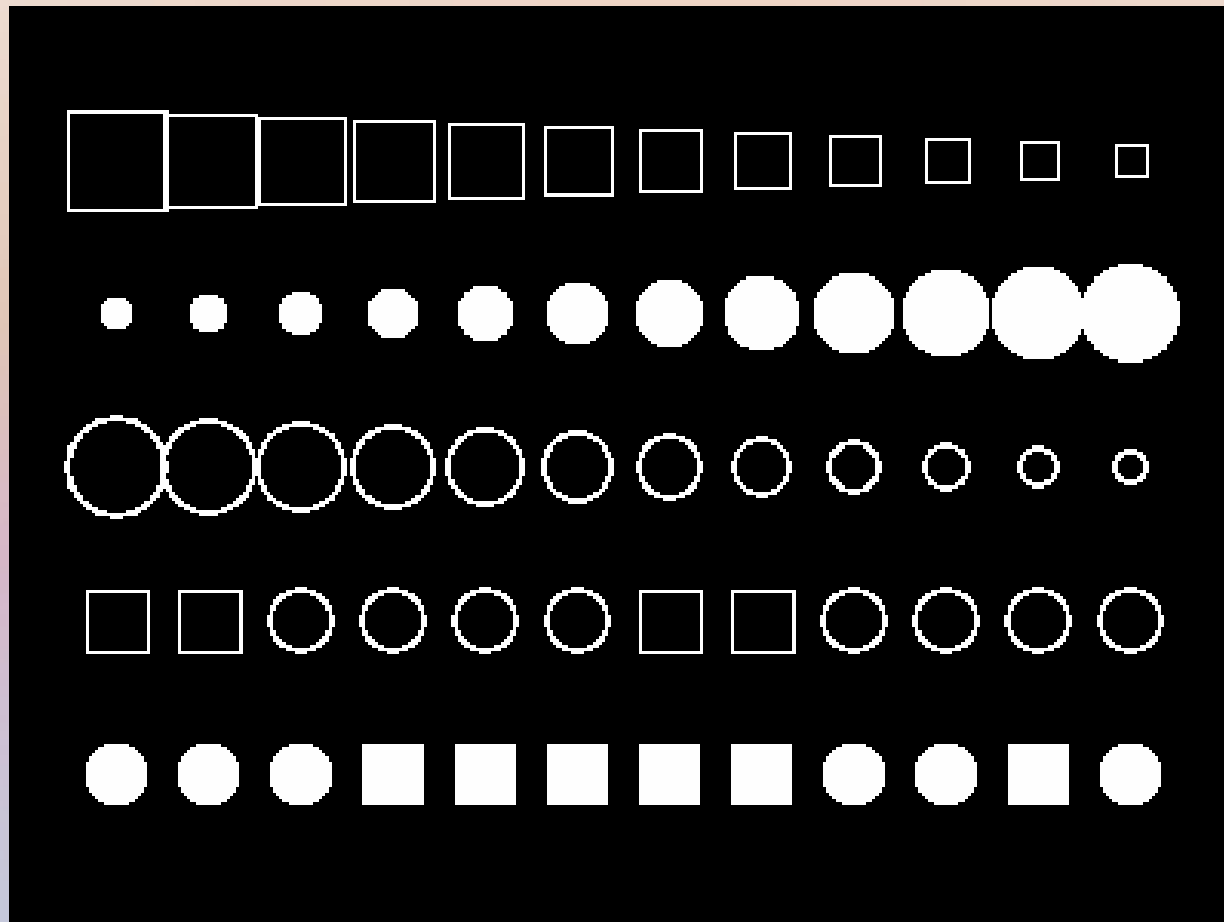
- Old (but simple) image processing technique
- Define a square odd-sided greyscale/colour bitmask
- Moves mask around input image, centred on midpoint of mask
- Each output pixel values are the normalised sum of original and mask pixels multiplied together
- Mask shapes help enhance similar in original
- Can be tricky to get mask sizes and values correct
- May not work with very noisy sources

Convolution 101 - example

- For arbitrary reasons we need to find all instances of 30px diameter open circles in an image
- Input image has variously sized filled and open squares and circles
- Construct a mask to match the desired shape
- Output of convolution process an image with bright points at center of discovered circles

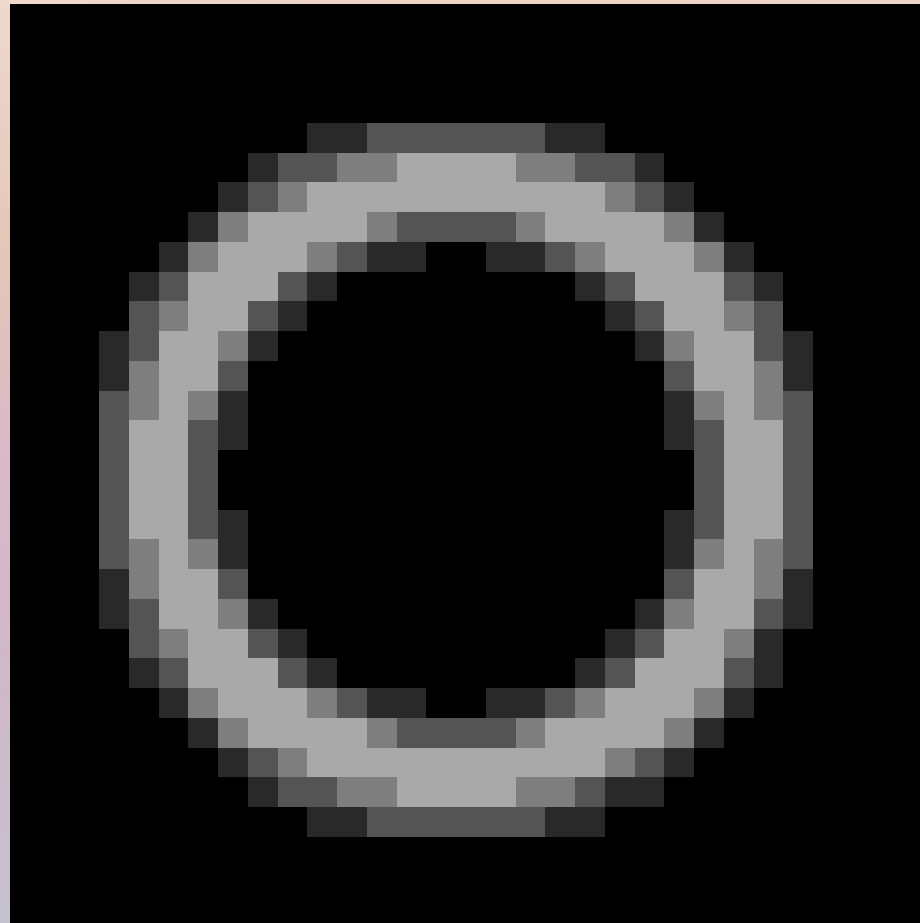
Convolution 101 – example

Sample input



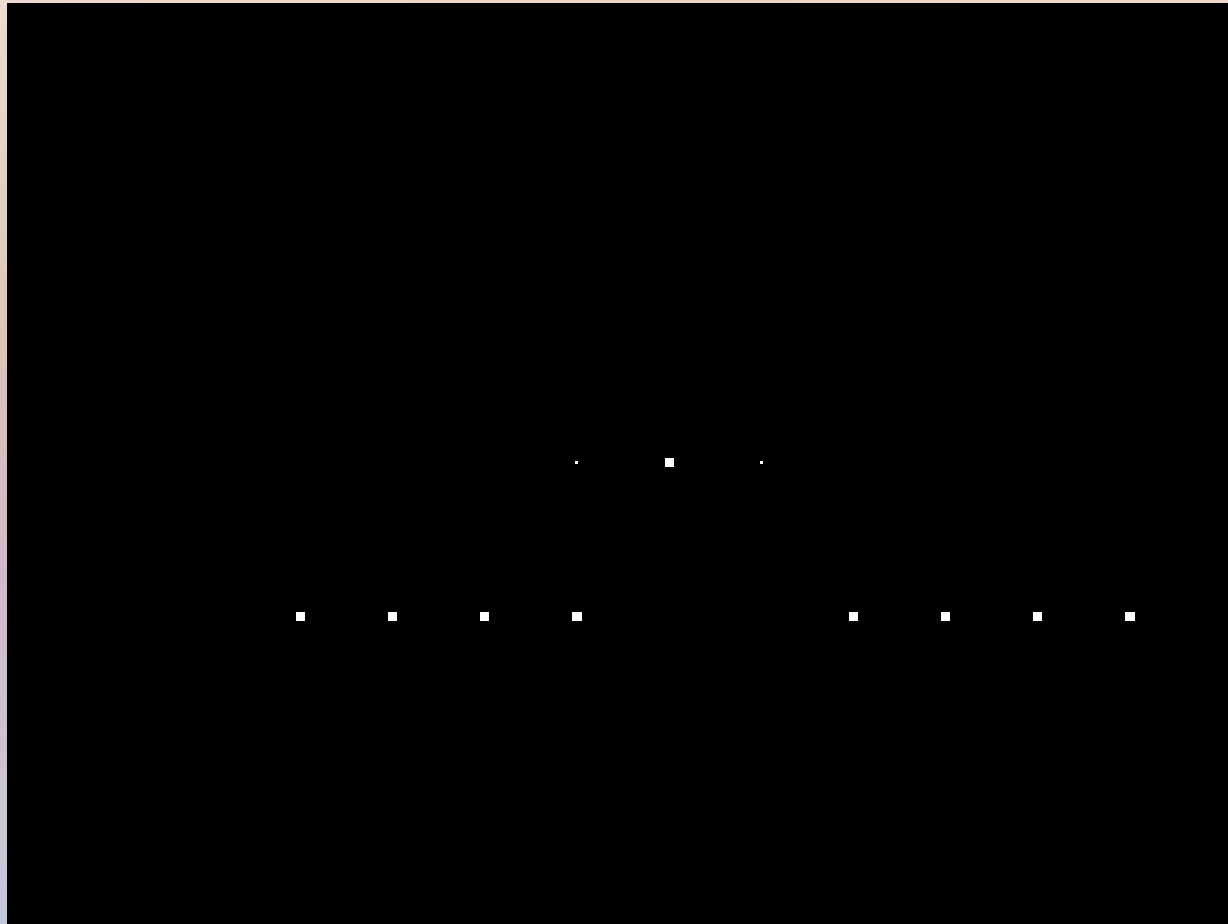
Convolution 101 – example

Convolution mask



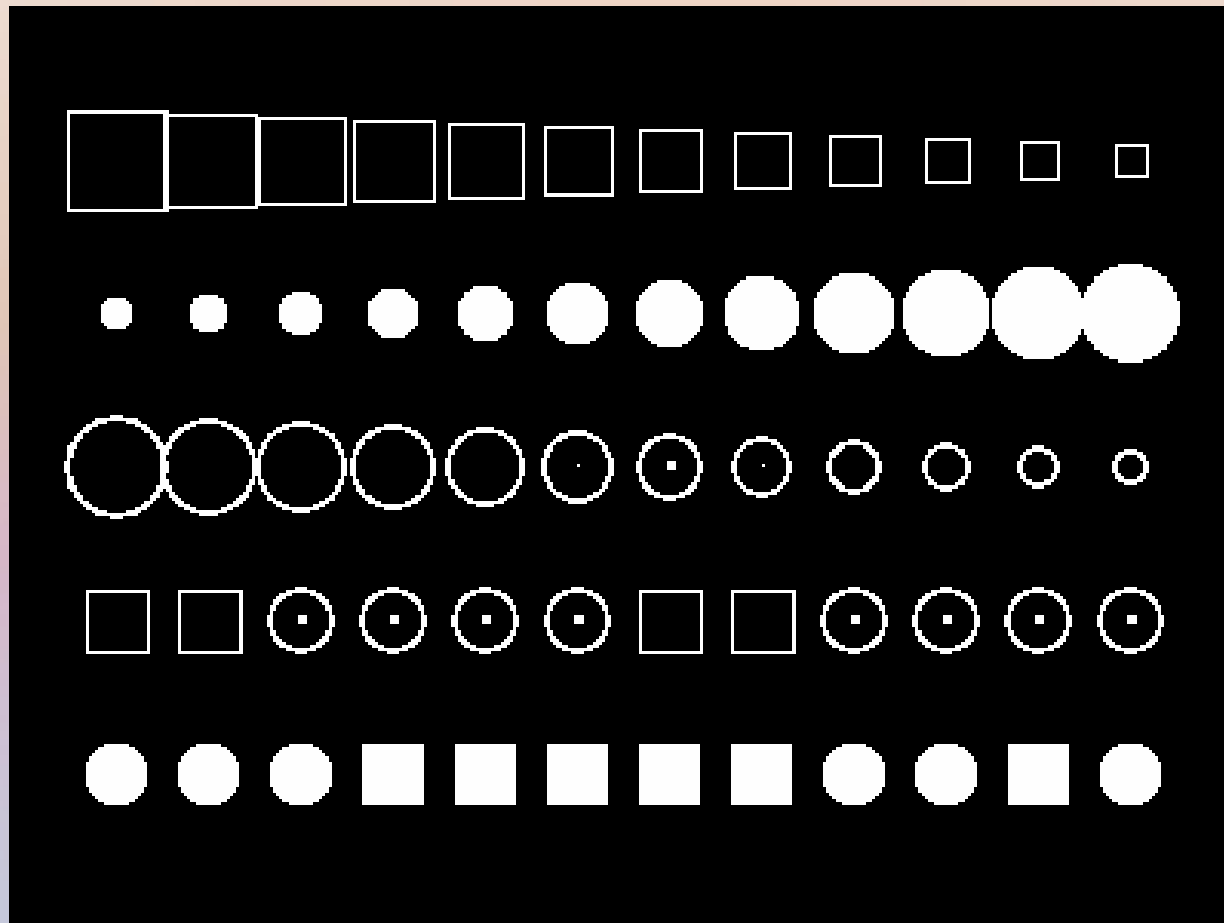
Convolution 101 example

Convolution output

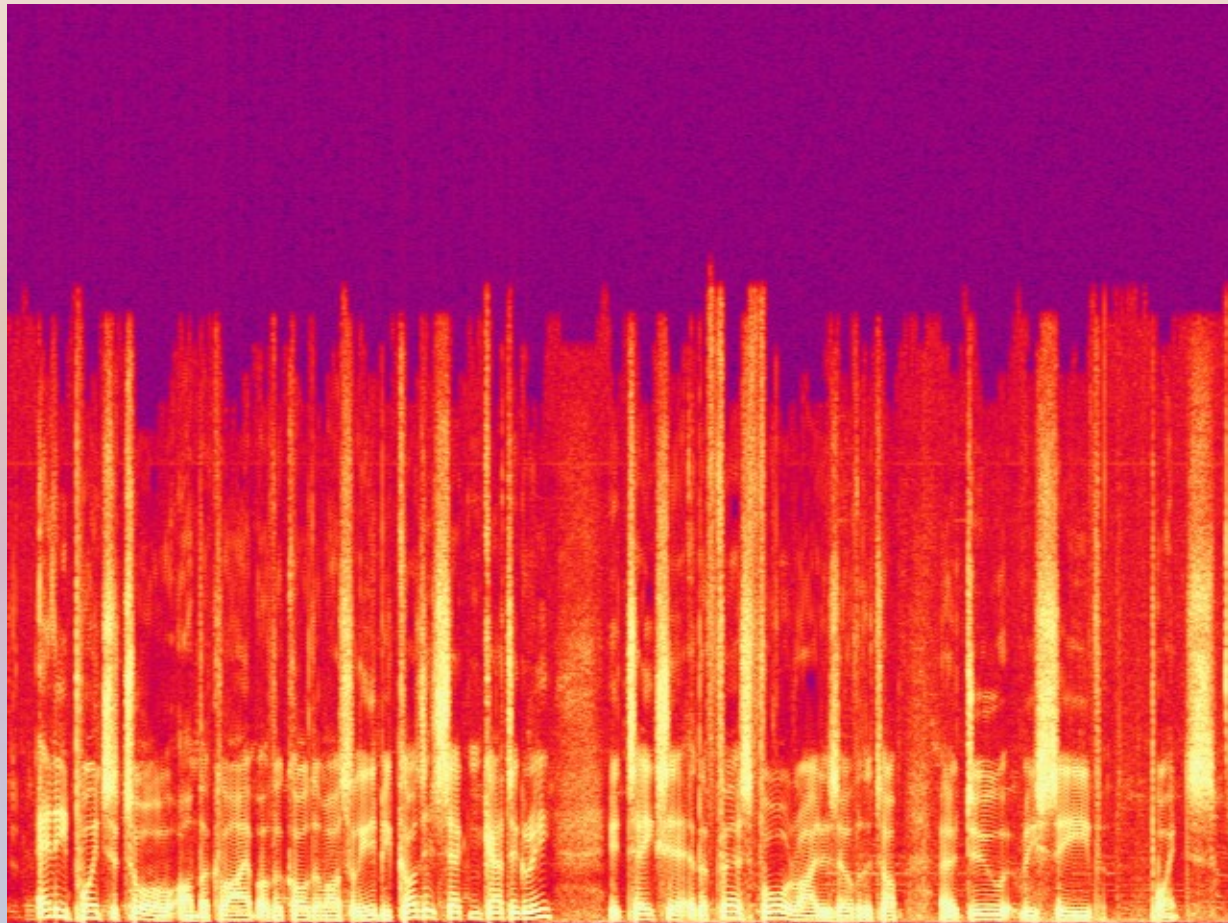


Convolution 101 – example

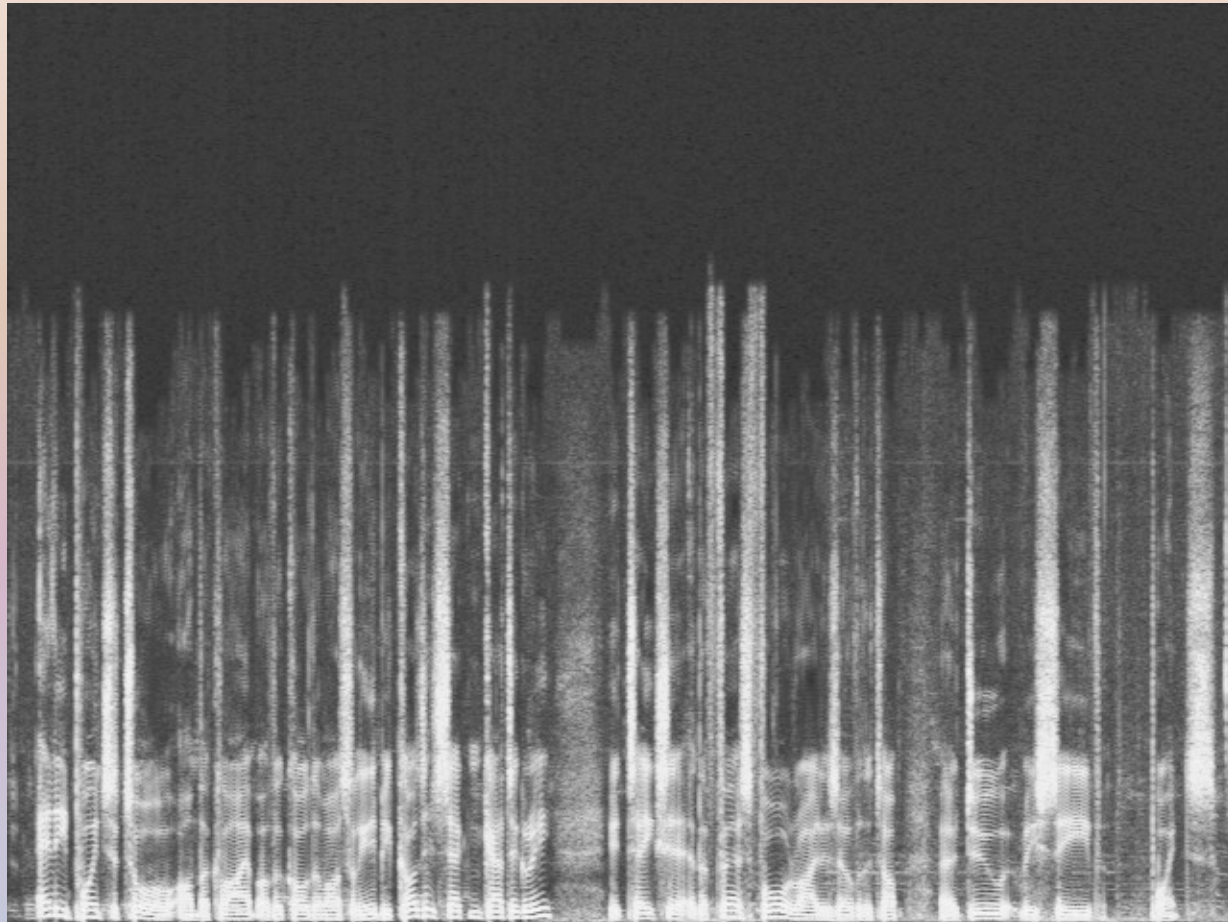
Output overlaid on input



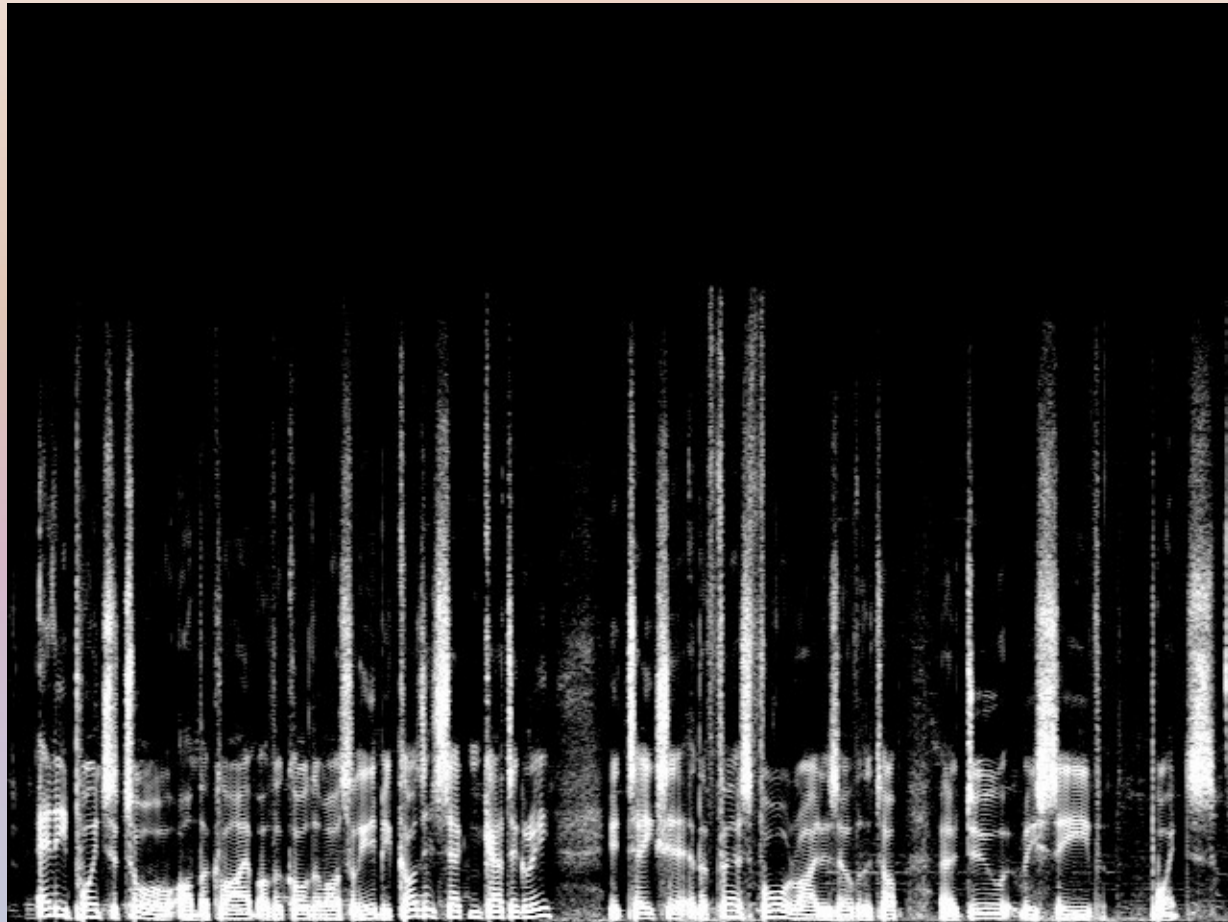
Original “boring” FFT PNG



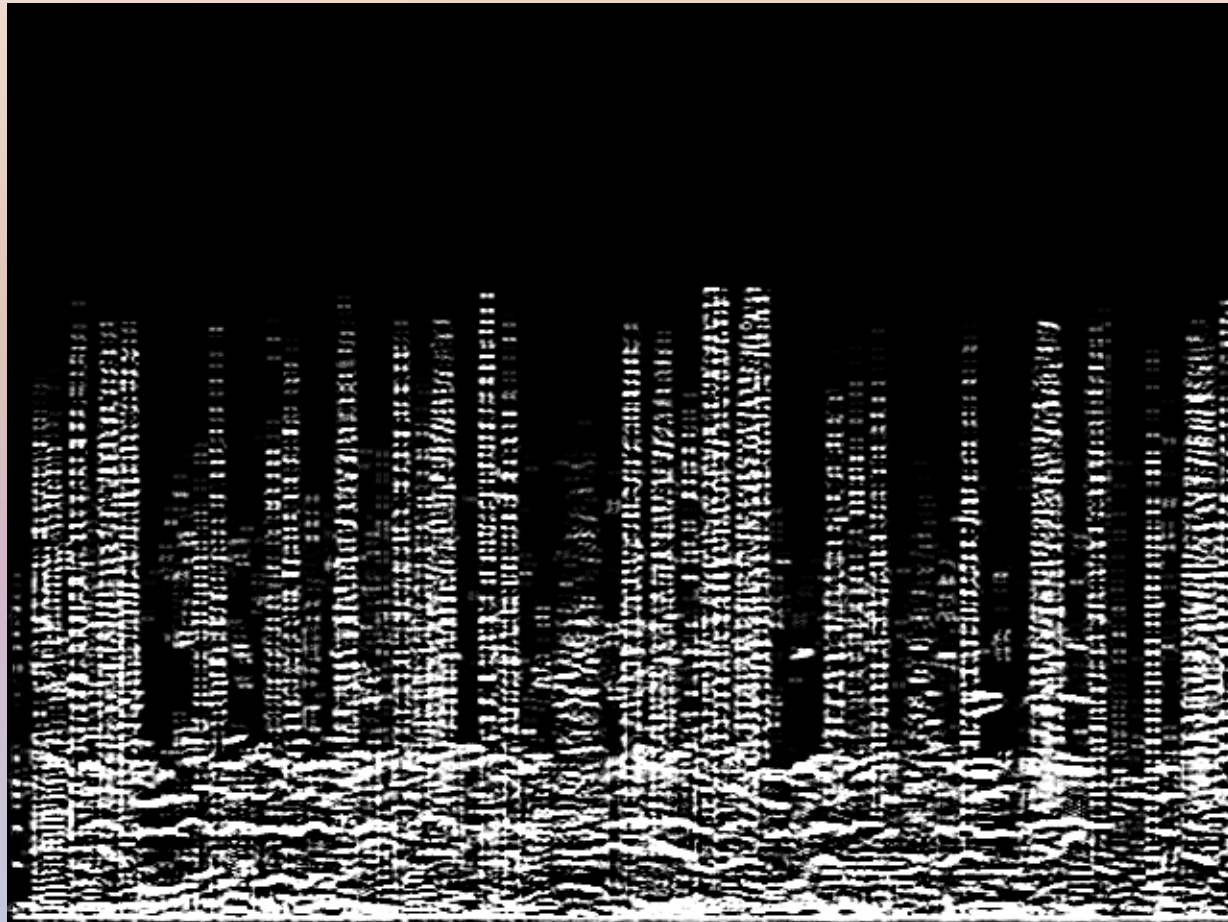
FFT greyscale



Normalised



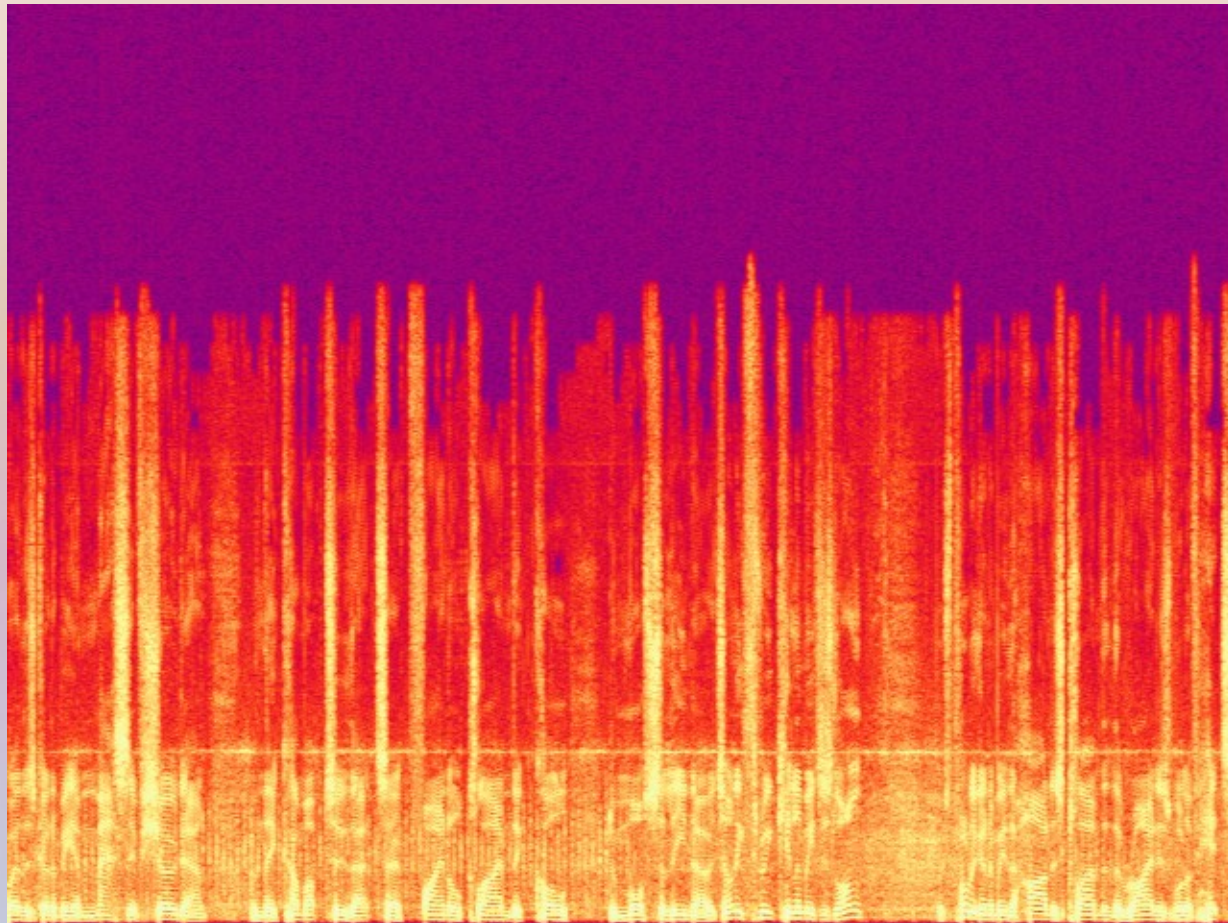
Convolved



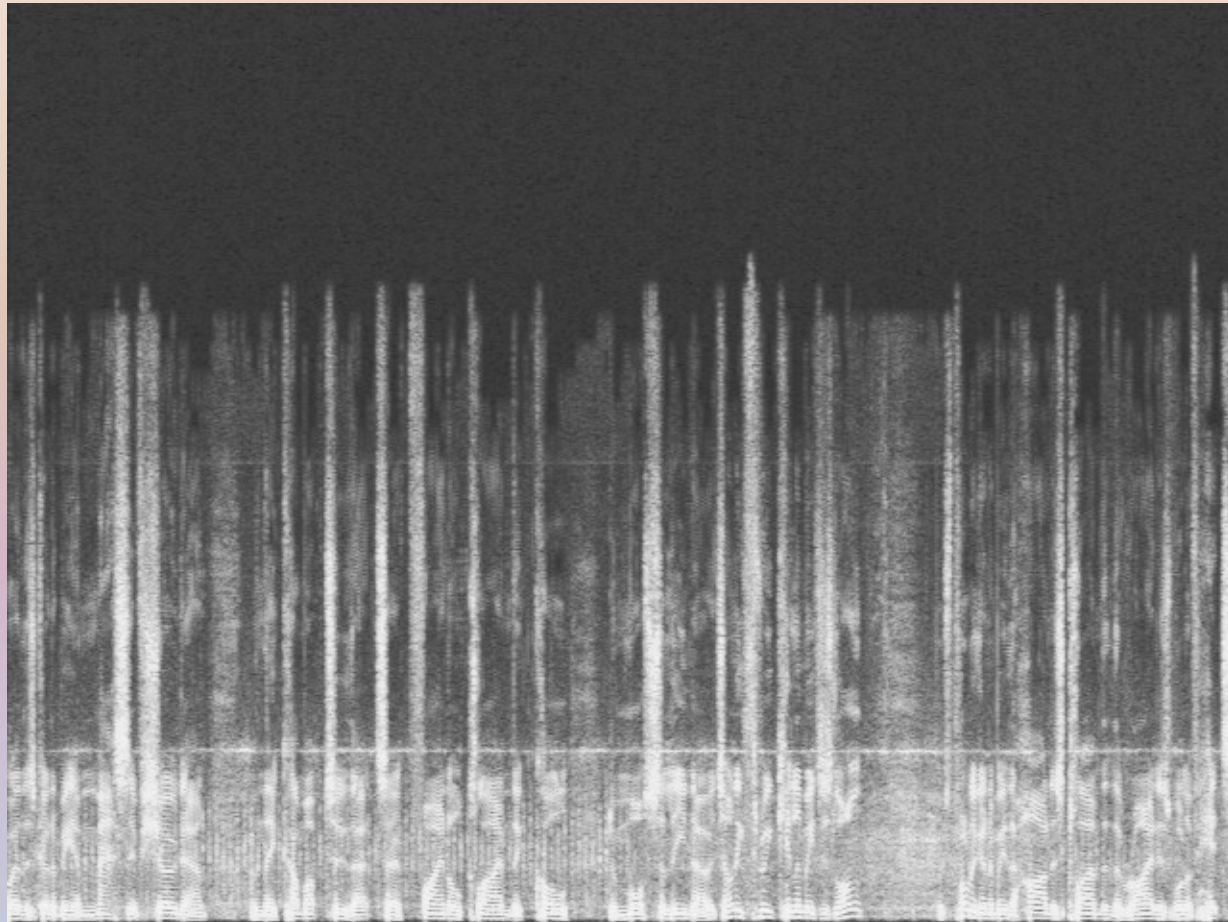
Cropped



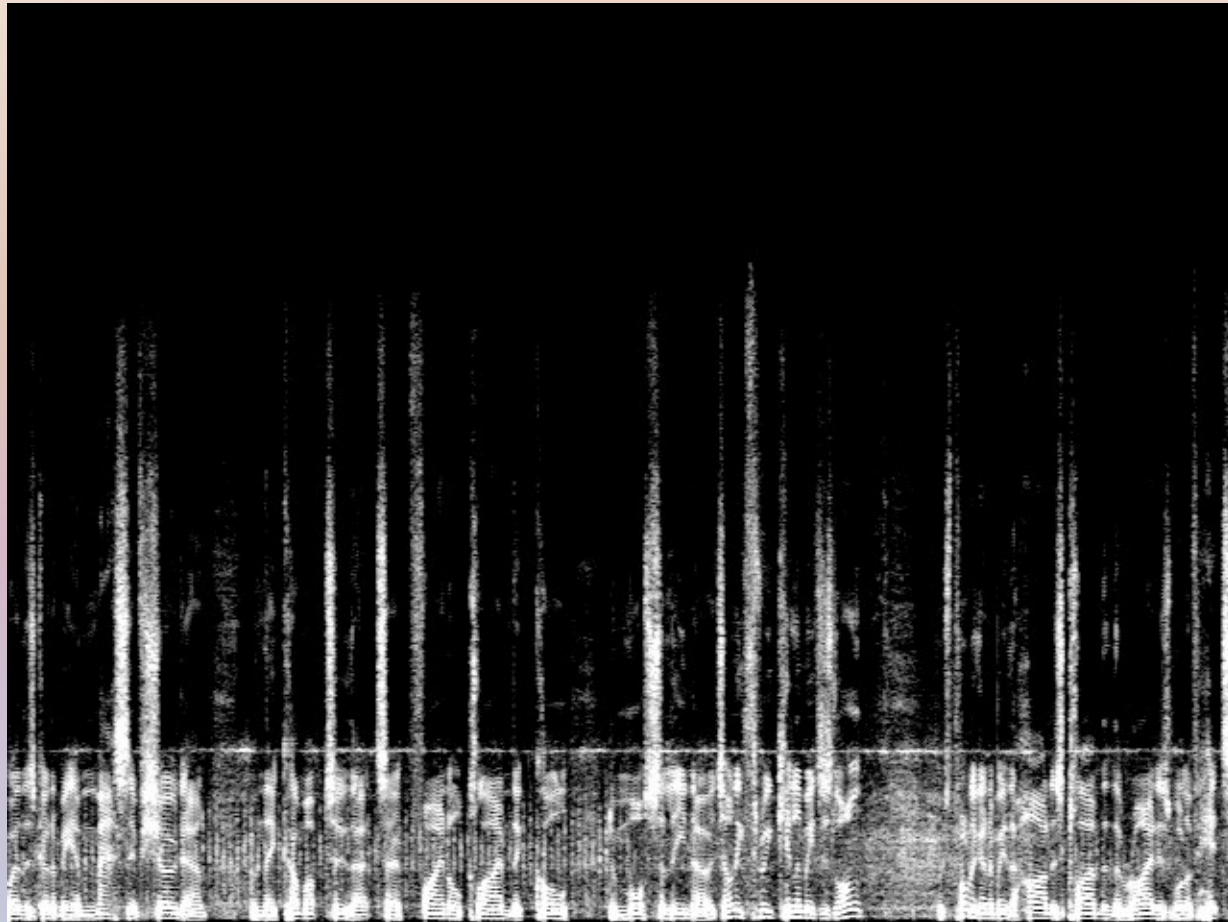
Original “interesting” FFT PNG



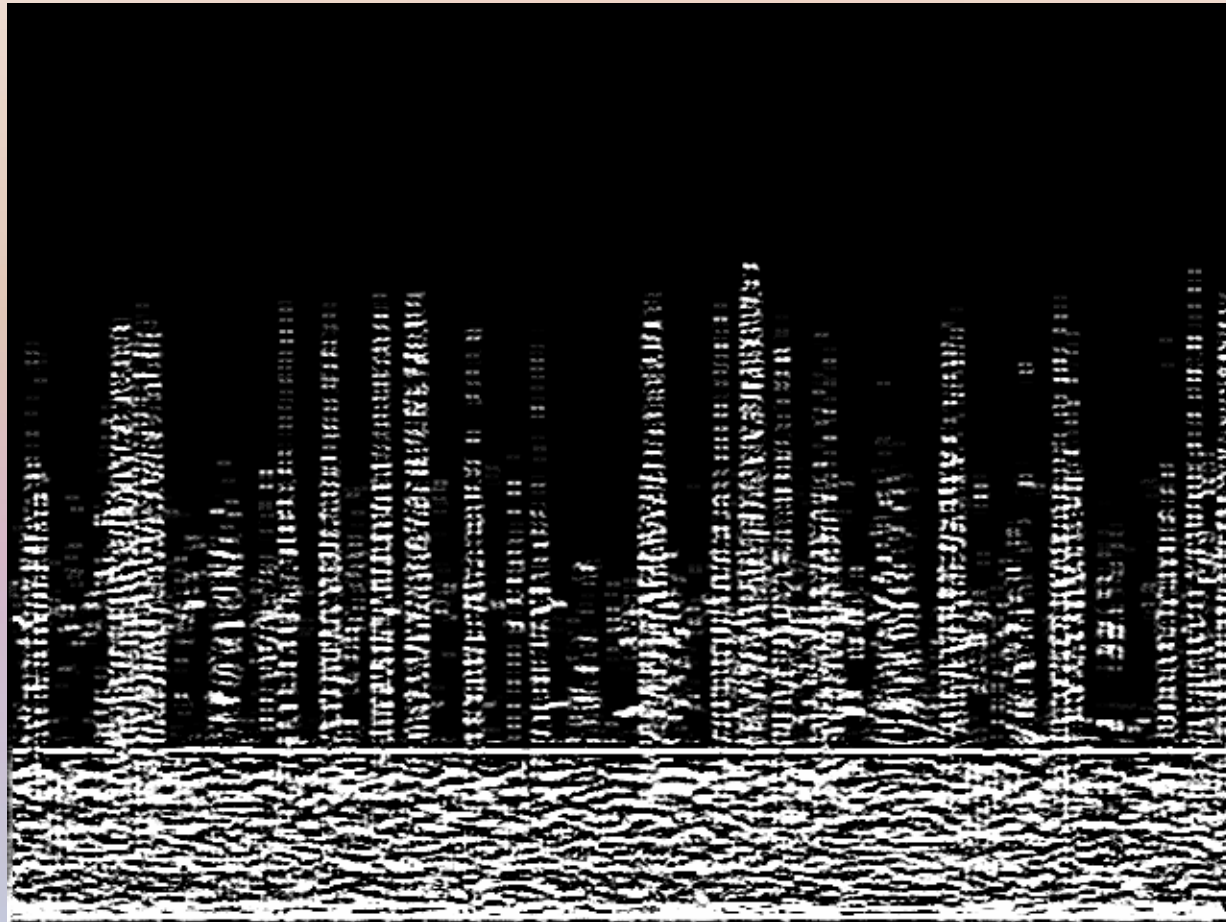
FFT greyscale



Normalised



Convolved



Cropped

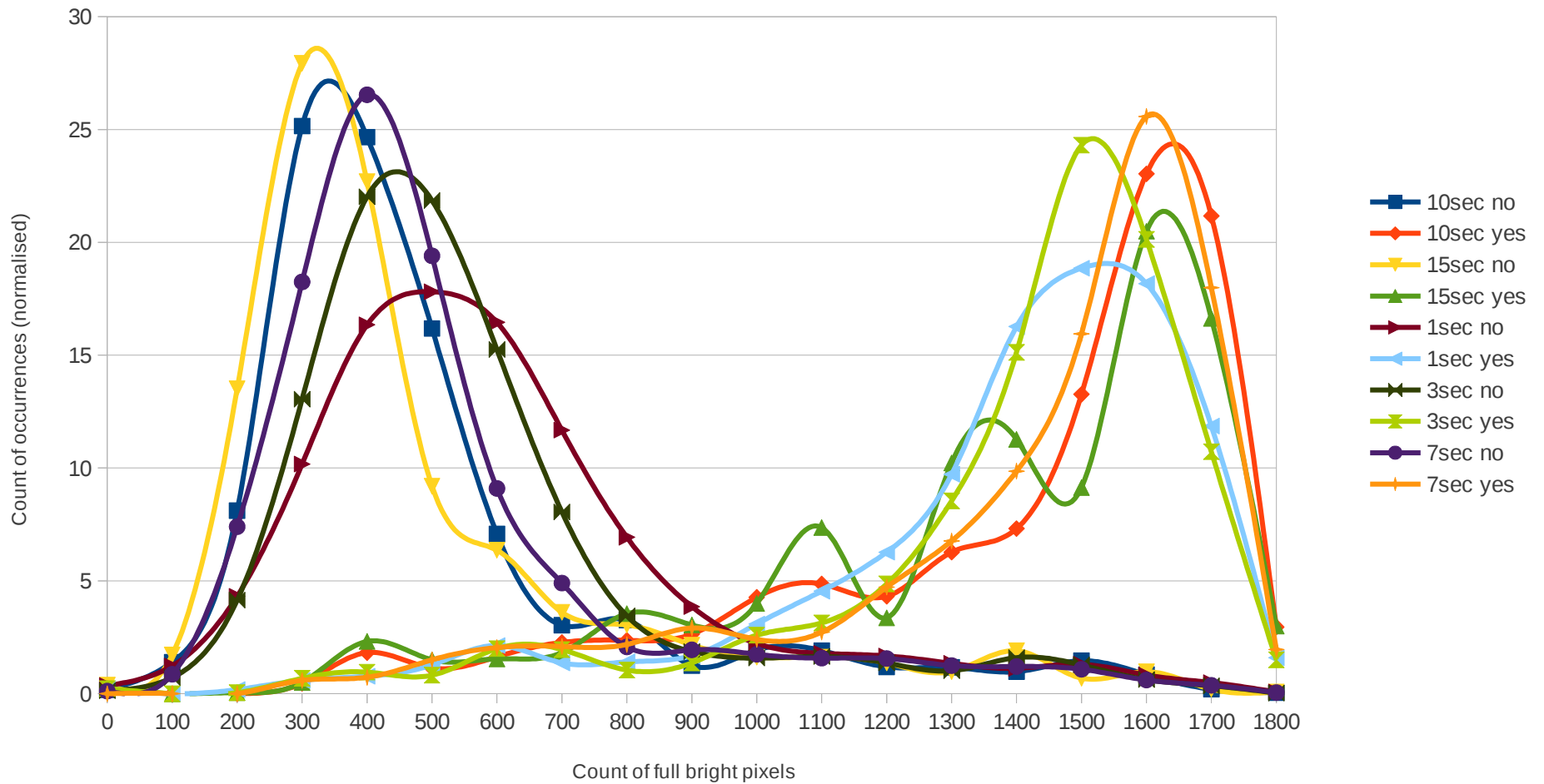


Histogram Comparison

brightness	tone	no tone
0	59	863
1	0	9
2	0	4
3	0	7
4	0	6
5	1	2
:	:	:
:	:	:
250	1	2
251	2	2
252	2	1
253	0	2
254	0	2
255	1712	390

Fine Tuning Categorisation

Categorisation histogram



Details – dumping audio

```
mpplayer -quiet -dumpaudio -dumpfile /dev/stdout \  
  source.mpg \  
| mp3splt -Q -k -t 0.7.0 -o @m3@s -d spool -  
  
mpg123 -qw chunk.wav chunk.mp3
```


Details – tone scanning

```
sndfile-spectrogram --no-border chunk.wav \  
 640 480 /dev/stdout \  
| pngtopnm \  
| ppmtopgm \  
| pnmnorm -bpercent 70 \  
| pnmpad -top 31 -bottom 31 -left 31 -right 31 \  
| pnmconvol mask.pgm \  
| pnmcut -left 31 -right 671 -top 309 -bottom 323 \  
| ppmhist -noheader -sort=rgb \  
| sed -ne '/255.*255.*255.*255/!b' -e 's/.* //' -ep
```

Details – convert/extract

```
mencoder -tskeepbroken -edl extract.edl \  
-of avi -o extract.avi \  
-oac mp3lame -lameopts abr=128 -audio-delay -0.100 \  
-ovc xvid \  
-xvidencopts bitrate=1200:max_bframes=0:vhq=4 \  
-vf scale=640:352 -aspect 16:9 \  
source.mpg
```

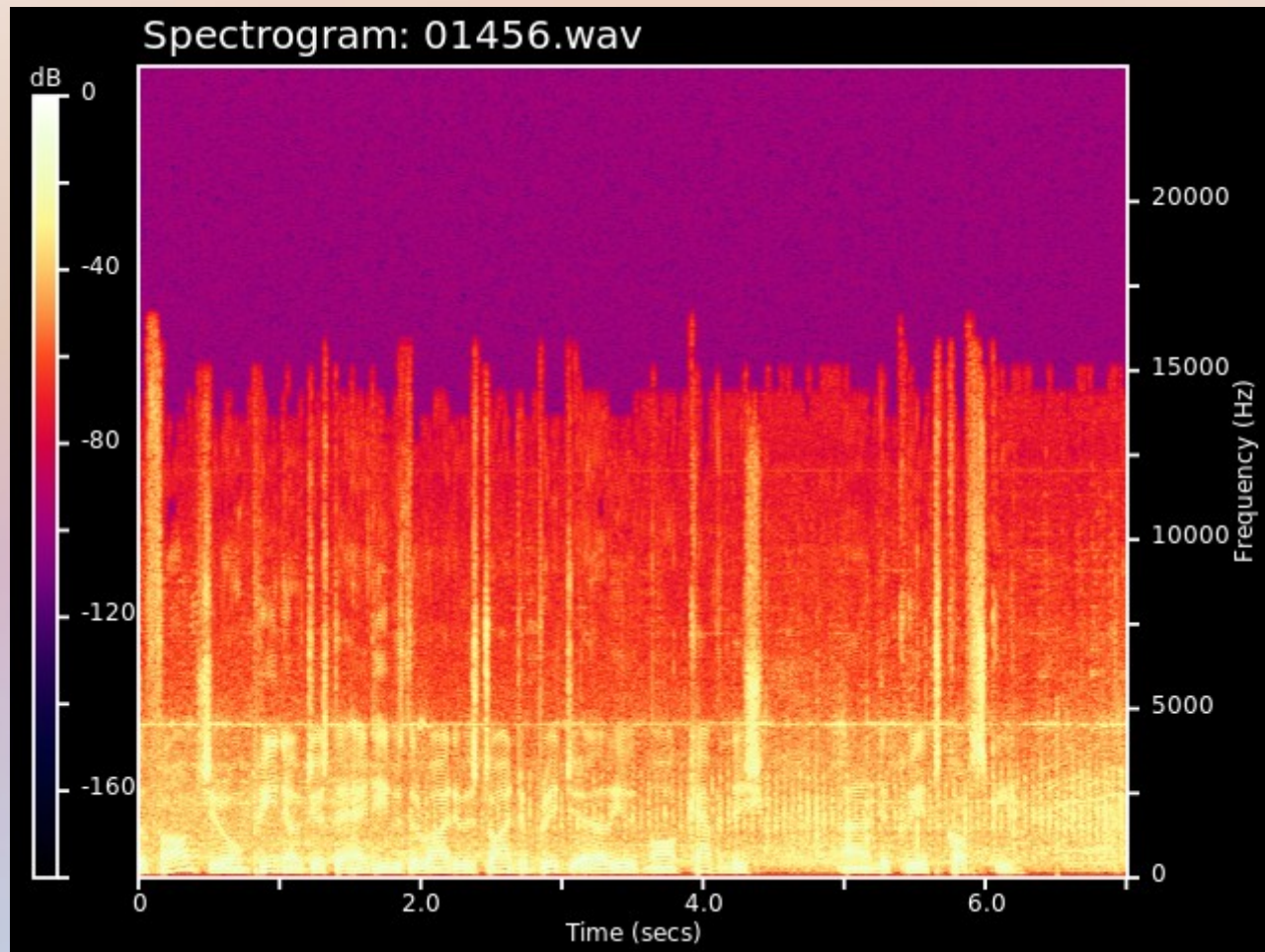
Final thoughts – Tour de France

- Still too many shots of cyclists, but not up-close
- Depends heavily on edit technique and audio mix
- mplayer/mencoder are really finicky
- AVI format is really finicky for seeking
- Using image-processing for audio-processing, wtf?

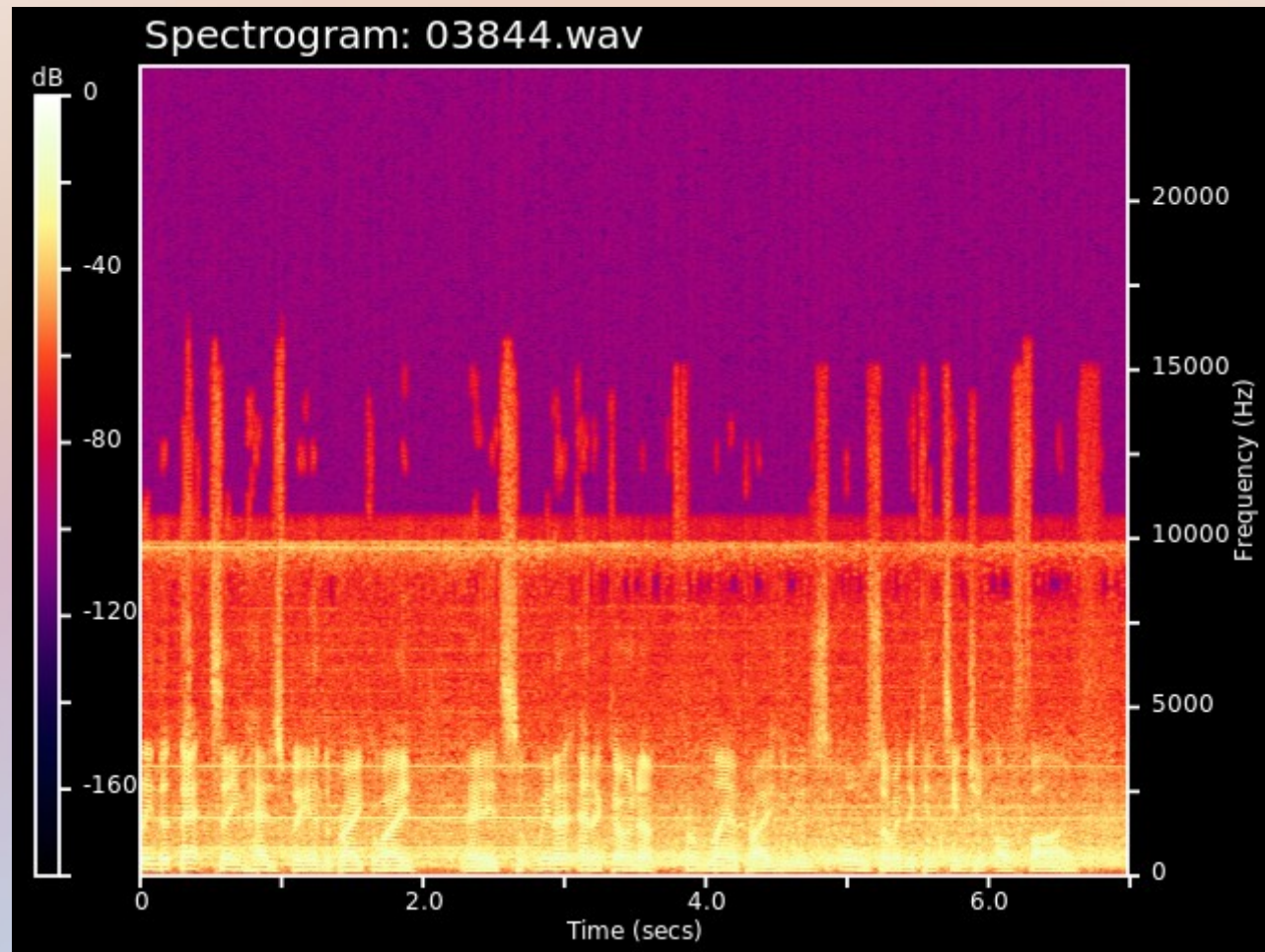
Final thoughts – Vuelta a España

- Different country, naturally the helicopters have a different accent – needed to redo convolution mask
- More smear in audio signature results in less accurate detection – more false positives due to helicopter flying too near camera motorcycles
- Less of race broadcast by SBS – only 8 stages in full
- Highlights package tends to focus on actual race, less on scenery

Helicopter accents - French



Helicopter accents - Spanish



Questions?

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