# 數字媒體技術基礎作業

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### 1 摘要

本作业主题为熵编码,在 ITM 进行改进与准备。此为测试前准备报告,报告对 ITM 15 的 lencod 目录下的 biariencode.h 中的  $B\_BITS10$  进行实验,将事前准备的 5 个测试影片进行测试,并汇整所产生的 \*.bit 档案大小,最后绘制成图。

### 2 事前

在此制作 5 个 10 秒与 5 个 4 秒的测试影片,并转成 YUV 影像,其素材取自深圳市大学城北大校区邻近图书馆与图书馆咖啡厅一带,内容包含了图书馆咖啡厅、图书馆旁的步道、图书馆内书架陈列、图书馆旁的草皮与隐藏人物。各视频录制约 10 秒,并同时准备 4 秒的版本,最后再输出乘 YUV。

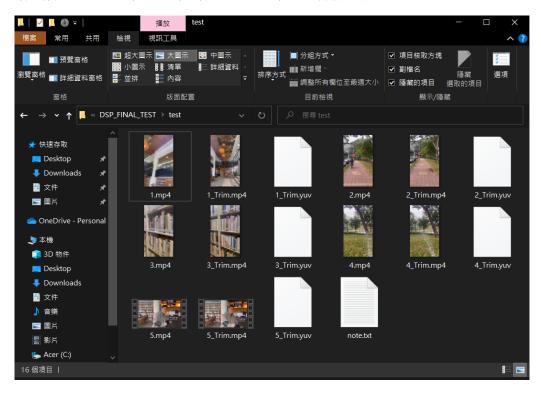


Fig. 1. 测试资料表列结果

# 3 指令

首先使用 FFMPEG 产生 YUV 档案,其产生过程的纪录如下。

1. 图书馆咖啡厅

```
(base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test > ffmpeg -i 1_Trim.mp4 -s 320
1
      x240 -pix_fmt yuv420p -r 15 1_Trim.yuv
   ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
2
      2000-2021 the FFmpeg developers
     built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
3
4
     configuration: --enable-gpl --enable-version3 --enable-static --disable-
         w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
         -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
         enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
        libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
         --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
         enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
        libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-freiOr
          --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
         libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
         enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
         dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
         --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
         enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
         libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
         enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
          --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
         enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
         chromaprint
     libavutil
                          6.100 / 57.
5
                     57.
                                       6.100
6
     libavcodec
                     59.
                          9.100 / 59.
                                       9.100
                          5.100 / 59.
     libavformat
                     59.
                                       5.100
7
8
     libavdevice
                     59.
                          0.101 / 59.
                                       0.101
                          9.100 / 8.
     libavfilter
                      8.
                                       9.100
9
     libswscale
10
                      6.
                          1.100 /
                                   6.
                                       1.100
     libswresample
                          0.100 / 4.
                                       0.100
11
                      4.
                          0.100 / 56. 0.100
     libpostproc
                     56.
12
13
   Input #0, mov, mp4, m4a, 3 gp, 3 g2, mj2, from '1_Trim.mp4':
     Metadata:
14
       major_brand
                        : mp42
15
       minor_version
                       : 0
16
       compatible_brands: mp41isom
17
       creation_time
                      : 2021-12-14T01:47:50.000000Z
18
     Duration: 00:00:04.19, start: 0.000000, bitrate: 3808 kb/s
19
     Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 544
20
         x960 [SAR 1:1 DAR 17:30], 3700 kb/s, 30 fps, 30 tbr, 30k tbn (default)
       Metadata:
21
22
         creation_time
                          : 2021-12-18T06:23:36.000000Z
         handler_name
                          : VideoHandler
23
24
         vendor_id
                          : [0][0][0][0]
                          : AVC Coding
25
         encoder
```

```
Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
26
         fltp, 180 kb/s (default)
        Metadata:
27
28
          creation_time
                          : 2021-12-18T06:23:36.000000Z
                          : SoundHandler
29
          handler_name
          vendor_id
                          : [0][0][0][0]
30
   Stream mapping:
31
     Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
32
   Press [q] to stop, [?] for help
33
   Output #0, rawvideo, to '1_Trim.yuv':
34
35
     Metadata:
        major_brand
36
                        : mp42
        minor_version
                        : 0
37
38
        compatible_brands: mp41isom
                        : Lavf59.5.100
39
     Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
40
         ), 320x240 [SAR 17:40 DAR 17:30], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
         default)
41
       Metadata:
                          : 2021-12-18T06:23:36.000000Z
          creation_time
42
          handler_name
                          : VideoHandler
43
          vendor id
                          : [0][0][0][0]
44
          encoder
                          : Lavc59.9.100 rawvideo
45
            63 fps=0.0 q=-0.0 Lsize=
                                          7088kB time = 00:00:04.20 bitrate = 13824.0
   frame=
46
       kbits/s dup=0 drop=60 speed=8.21x
47
   video:7088kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
       overhead: 0.000000%
   (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
48
```

#### 2. 图书馆旁的步道

```
(base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test > ffmpeg -i 2_Trim.mp4 -s 320
1
     x240 -pix_fmt yuv420p -r 15 2_Trim.yuv
  ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
2
     2000-2021 the FFmpeg developers
    built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
3
    configuration: --enable-gpl --enable-version3 --enable-static --disable-
4
        w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
        -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
        enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
        libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
        --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
        enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
       libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-freiOr
         --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
        libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
        enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
        dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
```

```
--enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
         enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
         libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
         enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
          --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
         enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
         chromaprint
     libavutil
                     57.
                          6.100 / 57.
 5
                                        6.100
     libavcodec
                     59.
                          9.100 / 59.
                                        9.100
 6
     libavformat
                          5.100 / 59.
 7
                     59.
                                        5.100
     libavdevice
                     59.
                          0.101 / 59.
 8
                                        0.101
     libavfilter
                          9.100 /
 9
                      8.
                                    8.
                                        9.100
     libswscale
                          1.100 /
                                        1.100
10
                      6.
                                    6.
11
     libswresample
                      4.
                          0.100 / 4.
                                        0.100
                          0.100 / 56. 0.100
     libpostproc
                     56.
12
   Input #0, mov, mp4, m4a, 3 gp, 3 g2, mj2, from '2_Trim.mp4':
13
     Metadata:
14
        major_brand
15
                        : mp42
        minor_version
                        : 0
16
        compatible_brands: mp41isom
17
        creation_time
                        : 2021-12-14T01:47:20.00000Z
18
     Duration: 00:00:04.98, start: 0.000000, bitrate: 11162 kb/s
19
     Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 720
20
         x1280 [SAR 1:1 DAR 9:16], 11302 kb/s, 30 fps, 30 tbr, 30k tbn (default)
21
       Metadata:
                          : 2021-12-18T06:24:19.000000Z
22
          creation_time
          handler_name
                          : VideoHandler
23
         vendor_id
                          : [0][0][0][0]
24
          encoder
                          : AVC Coding
25
     Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
26
         fltp, 180 kb/s (default)
27
       Metadata:
28
          creation_time
                          : 2021-12-18T06:24:19.000000Z
         handler_name
                          : SoundHandler
29
          vendor_id
                          : [0][0][0][0]
30
31
   Stream mapping:
     Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
32
   Press [q] to stop, [?] for help
33
   Output #0, rawvideo, to '2_Trim.yuv':
34
35
     Metadata:
        major_brand
                        : mp42
36
        minor_version
                        : 0
37
        compatible_brands: mp41isom
38
                        : Lavf59.5.100
39
     Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
40
         ), 320x240 [SAR 27:64 DAR 9:16], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
         default)
```

```
41
       Metadata:
          creation_time : 2021-12-18T06:24:19.000000Z
42
          handler name
                           : VideoHandler
43
44
          vendor_id
                           : [0][0][0][0]
          encoder
                           : Lavc59.9.100 rawvideo
45
             75 fps = 0.0 q = -0.0 Lsize =
                                          8438kB time = 00:00:05.00 bitrate = 13824.0
46
   frame=
       kbits/s dup=1 drop=71 speed= 5.6x
   video:8438kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
47
       overhead: 0.000000%
   (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
48
```

```
3. 图书馆内书架陈列
   (base) \ PS \ D: \ USERDATA \ Desktop \ DSP\_FINAL\_TEST \ test > \ ffmpeg \ -i \ 3\_Trim \ .mp4 \ -s \ 320
1
      x240 -pix_fmt yuv420p -r 15 3_Trim.yuv
   ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
2
       2000-2021 the FFmpeg developers
     built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
3
4
     configuration: --enable-gpl --enable-version3 --enable-static --disable-
         w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
         -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
         enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
         libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
         --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
         enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
         libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-freiOr
          --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
         libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
         enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
         dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
         --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
         enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
         libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
         enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
          --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
         enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
         chromaprint
     libavutil
                          6.100 / 57.
5
                     57.
                                       6.100
     libavcodec
                          9.100 / 59.
                     59.
                                       9.100
6
     libavformat
                          5.100 / 59.
7
                     59.
                                       5.100
8
     libavdevice
                     59.
                          0.101 / 59.
                                       0.101
                          9.100 / 8.
     libavfilter
9
                      8.
                                       9.100
     libswscale
                          1.100 /
                                       1.100
                      6.
                                   6.
10
     libswresample
                      4.
                          0.100 / 4.
                                       0.100
11
                          0.100 / 56.
12
     libpostproc
                     56.
                                       0.100
13
   Input #0, mov,mp4,m4a,3gp,3g2,mj2, from '3_Trim.mp4':
     Metadata:
14
15
       major_brand
                        : mp42
```

```
minor_version : 0
16
        compatible_brands: mp41isom
17
        creation time
                        : 2021-12-14T01:47:41.000000Z
18
     Duration: 00:00:04.89, start: 0.000000, bitrate: 3705 kb/s
19
     Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 544
20
         x960 [SAR 1:1 DAR 17:30], 3643 kb/s, 30 fps, 30 tbr, 30k tbn (default)
       Metadata:
21
          creation_time
                          : 2021-12-18T06:24:54.000000Z
22
         handler_name
                          : VideoHandler
23
         vendor_id
                          : [0][0][0][0]
24
         encoder
                          : AVC Coding
25
     Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
26
         fltp, 176 kb/s (default)
27
       Metadata:
                        : 2021-12-18T06:24:54.000000Z
          creation_time
28
         handler_name
                          : SoundHandler
29
          vendor_id
                          : [0][0][0][0]
30
31
   Stream mapping:
32
     Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
   Press [q] to stop, [?] for help
33
   Output #0, rawvideo, to '3_Trim.yuv':
34
     Metadata:
35
        major_brand
                        : mp42
36
        minor_version
                        : 0
37
        compatible_brands: mp41isom
38
                        : Lavf59.5.100
39
        encoder
     Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
40
         ), 320x240 [SAR 17:40 DAR 17:30], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
         default)
       Metadata:
41
                          : 2021-12-18T06:24:54.000000Z
42
          creation_time
43
         handler_name
                          : VideoHandler
44
          vendor_id
                          : [0][0][0][0]
          encoder
                          : Lavc59.9.100 rawvideo
45
   frame=
             74 fps = 0.0 q = -0.0 Lsize =
                                         8325kB time=00:00:04.93 bitrate=13824.0
46
       kbits/s dup=1 drop=69 speed=12.2x
47
   video:8325kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
       overhead: 0.000000%
   (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
48
```

#### 4. 图书馆旁的草皮

```
w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
         -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
         enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
         libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
         --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
         enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
         libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-freiOr
          --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
         libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
         enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
         dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
         --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
         enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
         libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
         enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
          --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
         enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
         chromaprint
5
     libavutil
                     57.
                          6.100 / 57.
                                       6.100
     libavcodec
                     59.
                          9.100 / 59.
                                       9.100
6
                          5.100 / 59.
7
     libavformat
                     59.
                                       5.100
     libavdevice
                     59.
                          0.101 / 59.
8
                                       0.101
     libavfilter
9
                      8.
                          9.100 /
                                   8.
                                       9.100
                          1.100 / 6.
     libswscale
                      6.
                                       1.100
10
11
     libswresample
                      4.
                          0.100 / 4.
                                       0.100
                          0.100 / 56.
12
     libpostproc
                     56.
                                       0.100
   Input #0, mov, mp4, m4a, 3 gp, 3 g2, mj2, from '4_Trim.mp4':
13
     Metadata:
14
       major brand
                        : mp42
15
       minor_version
                        : 0
16
       compatible_brands: mp41isom
17
18
       creation_time
                       : 2021-12-14T01:47:31.000000Z
19
     Duration: 00:00:04.87, start: 0.000000, bitrate: 14394 kb/s
     Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 720
20
        x1280 [SAR 1:1 DAR 9:16], 14600 kb/s, 30 fps, 30 tbr, 30k tbn (default)
       Metadata:
21
                          : 2021-12-18T06:26:14.000000Z
         creation_time
22
         handler_name
                          : VideoHandler
23
         vendor_id
                          : [0][0][0][0]
24
25
         encoder
                          : AVC Coding
     Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
26
         fltp, 198 kb/s (default)
       Metadata:
27
                          : 2021-12-18T06:26:14.000000Z
28
         creation time
         handler_name
                          : SoundHandler
29
30
         vendor_id
                          : [0][0][0][0]
31
   Stream mapping:
```

```
Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
32
   Press [q] to stop, [?] for help
33
   Output #0, rawvideo, to '4_Trim.yuv':
34
35
     Metadata:
        major_brand
36
                        : mp42
        minor_version
37
                        : 0
        compatible_brands: mp41isom
38
                        : Lavf59.5.100
39
     Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
40
         ), 320x240 [SAR 27:64 DAR 9:16], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
         default)
41
       Metadata:
          creation_time
                          : 2021-12-18T06:26:14.000000Z
42
43
          handler_name
                          : VideoHandler
          vendor id
                          : [0][0][0][0]
44
          encoder
                          : Lavc59.9.100 rawvideo
45
             74 fps=0.0 q=-0.0 Lsize=
                                          8325kB time = 00:00:04.93 bitrate = 13824.0
   frame=
46
       kbits/s dup=1 drop=69 speed=5.28x
47
   video:8325kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
       overhead: 0.000000%
   (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
48
```

#### 5. 隐藏人物

```
(base) \ PS \ D: \ USERDATA \ Desktop \ DSP\_FINAL\_TEST \ test > \ ffmpeg \ -i \ 5\_Trim.mp4 \ -s \ 320
1
      x240 -pix_fmt yuv420p -r 15 5_Trim.yuv
  ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
2
      2000-2021 the FFmpeg developers
3
    built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
    configuration: --enable-gpl --enable-version3 --enable-static --disable-
4
        w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
        -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
        enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
        libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
        --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
        enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
        libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-freiOr
         --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
        libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
        enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
        dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
        --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
        enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
        libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
        enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
         --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
        enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
        chromaprint
```

```
5
     libavutil
                     57.
                           6.100 / 57.
                                        6.100
     libavcodec
                     59.
                           9.100 / 59.
 6
                                        9.100
     libavformat
                     59.
                           5.100 / 59.
                                        5.100
 7
     libavdevice
                           0.101 / 59.
 8
                     59.
                                        0.101
     libavfilter
                           9.100 /
 9
                      8.
                                    8.
                                        9.100
     libswscale
                           1.100 /
10
                      6.
                                    6.
                                        1.100
     libswresample
                      4.
                           0.100 / 4.
                                        0.100
11
                           0.100 / 56.
12
     libpostproc
                     56.
                                        0.100
   Input #0, mov,mp4,m4a,3gp,3g2,mj2, from '5_Trim.mp4':
13
14
     Metadata:
        major_brand
15
                        : mp42
16
        minor_version
                        : 0
        compatible_brands: mp41isom
17
18
        creation_time
                        : 2021-12-14T01:47:59.000000Z
     Duration: 00:00:04.93, start: 0.000000, bitrate: 4755 kb/s
19
     Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 1280
20
         x720 [SAR 1:1 DAR 16:9], 4733 kb/s, 30 fps, 30 tbr, 30k tbn (default)
21
       Metadata:
22
          creation_time
                          : 2021-12-18T06:27:01.000000Z
          handler_name
                           : VideoHandler
23
          vendor_id
                           : [0][0][0][0]
24
          encoder
                           : AVC Coding
25
     Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
26
         fltp, 179 kb/s (default)
27
       Metadata:
                           : 2021-12-18T06:27:01.000000Z
          creation_time
28
          handler_name
                          : SoundHandler
29
          vendor_id
                           : [0][0][0][0]
30
   Stream mapping:
31
     Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
32
   Press [q] to stop, [?] for help
33
34
   Output #0, rawvideo, to '5_Trim.yuv':
35
     Metadata:
        major_brand
                        : mp42
36
        minor_version
                        : 0
37
        compatible_brands: mp41isom
38
        encoder
                        : Lavf59.5.100
39
     Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
40
         ), 320x240 [SAR 4:3 DAR 16:9], q=2-31, 13824 kb/s, 15 fps, 15 tbn (default)
41
       Metadata:
          creation_time
                          : 2021-12-18T06:27:01.000000Z
42
          handler_name
                           : VideoHandler
43
          vendor_id
                           : [0][0][0][0]
44
                           : Lavc59.9.100 rawvideo
45
          encoder
             74 fps = 0.0 q = -0.0 Lsize =
                                          8325kB time=00:00:04.93 bitrate=13824.0
46
   frame=
       kbits/s dup=1 drop=70 speed=8.97x
   video:8325kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
47
```

```
overhead: 0.000000%

48 (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test >
```

#### 各指令记录如下:

```
ffmpeg -i 1_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 1_Trim.yuv
1
2
   ffmpeg -i 2_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 2_Trim.yuv
3
4
   ffmpeg -i 3_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 3_Trim.yuv
5
6
   ffmpeg -i 4_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 4_Trim.yuv
7
8
   ffmpeg -i 5_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 5_Trim.yuv
9
10
   ffplay -video_size 320x240 -i 1_Trim.yuv
11
12
   ffplay -video_size 320x240 -i 2_Trim.yuv
13
14
   ffplay -video_size 320x240 -i 3_Trim.yuv
15
16
   ffplay -video_size 320x240 -i 4_Trim.yuv
17
18
   ffplay -video_size 320x240 -i 5_Trim.yuv
19
```

#### 最后播放结果如下:

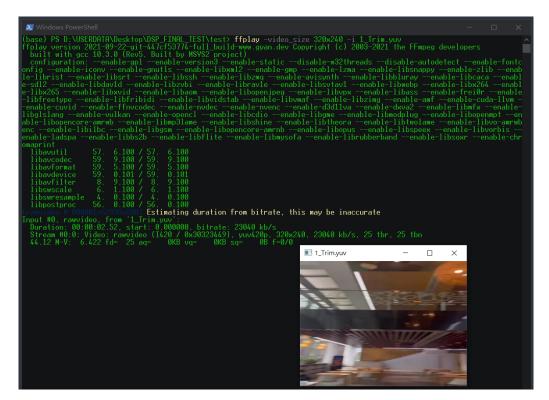


Fig. 2. 图书馆咖啡厅

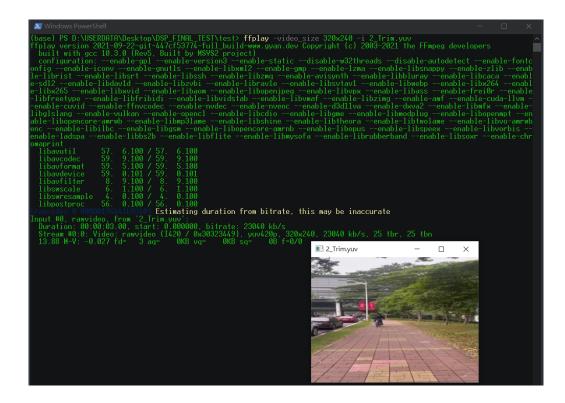


Fig. 3. 图书馆旁的步道

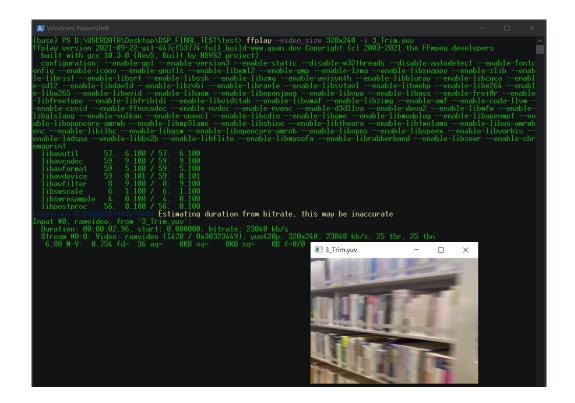


Fig. 4. 图书馆内书架陈列

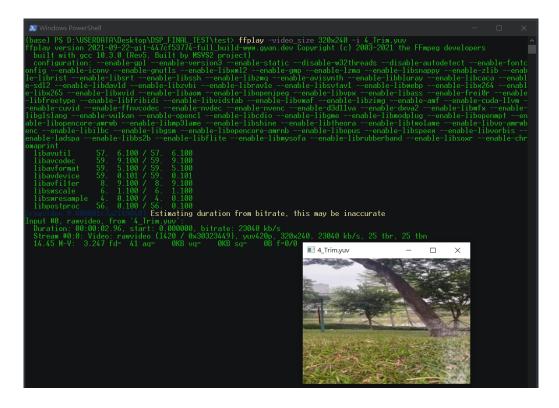


Fig. 5. 图书馆旁的草皮

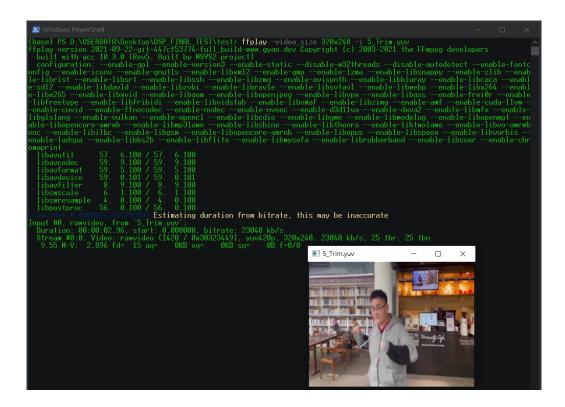


Fig. 6. 隐藏人物

## 4 结果

从实验结果可知,从10到9的阶段就有很大的效果呈现,而后续有反弹的微幅增加,但随后又下降。。

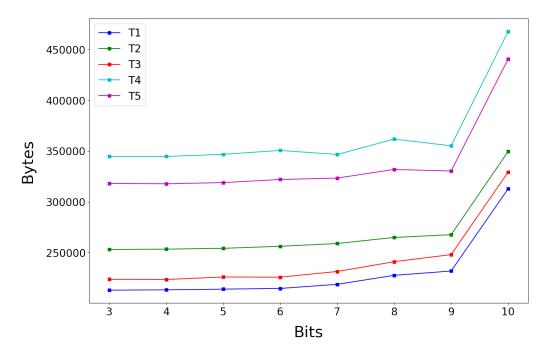


Fig. 7. 测试结果

```
★ 檔案(F) 編輯(E) 檢視(V) Git(G)
                              專案(P) 建置(B) 偵錯(D) 測試(S) 分析(N)
                                                                  工具(T)
 Debug - Win32
                                                   ▼ ▶ 本機 Windows 偵錯工具 ▼
(全域範圍)
            #define Ebits_to_go
                              (eep->Ebits_to_go)
                               (eep->Ecodestrm)
             #define Ecodestrm_len (eep->Ecodestrm_len)
             #define Ecodestrm_laststartcode (eep->Ecodestrm_laststartcode)
             #define B_BITS 10
      28
             #define ONE
#define HALF
                           (1 << B_BITS)
                           (1 \ll (B\_BITS-1))
             #define QUARTER (1 << (B_BITS-2))
             #define LG_PMPS_SHIFTNO 2
```

Fig. 8. 改动示意

	Α	В	С	D	Е	F
1		t1	t2	t3	t4	t5
2	3	212,974	253,078	223,633	344,657	318,124
3	4	213,280	253 <i>,</i> 364	223,457	344,646	317,772
4	5	213,978	254,166	225,934	346,771	318,889
5	6	214,666	256,183	225,771	350,569	321,964
6	7	218,722	258,902	231,373	346,586	323,349
7	8	227,560	264,885	240,985	361,756	331,842
8	9	231,819	267,600	247,982	355,130	330,324
9	10	312,726	349,487	329,182	467,713	440,491

Fig. 9. 数据呈现