Comparison of software and hardware video codecs from perspective of power consumption

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Abstract

Your abstract here.

Contents

1 Introduction

Video encoding and decoding are processes with many variables which can influence the output of whole process of video transfer. Visual quality of video is determined by chosen coding standard, its implementation and encoding settings. All these three key elements have direct impact on energy resources we need for completing encode. Video coding standard defines complexity of algorithm and usually the more effective compression the more complex algorithm - the more power demanding. There are many types of implementations but usually the more hardwired algorithms it uses the less power demanding it is. At last, used encoding settings determine time needed for compression. That also means power necessary for encode. From this point of view, power consumption one, it is interesting to create comparison of different video codecs to see how much quality of video costs in used energy.

1.1 Theoretical framework/literature study

We had to compile FFmpeg with support of NVENC and QSV.[1, 2]

1.1.1 Peak Signal-to-Noise Ratio taking into account Contrast Sensitivity Function (CSF) and between-coefficient contrast masking of DCT basis functions (PSNR-HVS-M)

In dB. More is better.

1.1.2 Multi-Scale Structural Similarity (MS-SSIM)

From 0 to 1. More is better.

1.1.3 Video Multi-Method Assessment Fusion (VMAF)

Newly developed metric by Netflix. Based on machine learning. From 0 to 100. More is better.

1.2 Research questions, hypotheses

Hardware accelerated codecs are faster but with lower quality and lower power consumption.

2 Method

We choose three test sequences, each 500 frames long. More in table 1

Table 1: Parameters of test sequences

Sequence	crowd_run_2160p50.y4m	old_town_cross_2160p50.y4m	sintel.y4m
Resolution	3840×2160	3840×2160	4096×1744
framerate	50p	50p	24p
# of frames	500	500	500
subsampling	4 : 2 : 0	4 : 2 : 0	4 : 2 : 0
size in bytes	6 220 803 036	6 220 803 036	5 357 571 060

Whole process was done for all codecs as follows:

1. Power measuring tools are enabled
2. Encoding proceeds
3. Power measuring tools are disabled

4. Encoded video is trans-coded to YUV420P
5. Quality is measured

This is done for all three chosen sequences, all chosen codecs and all presets available in bit-rates from 500 kbit/s to 5000 kbit/s with 500 kbit steps and then up to 15 000 kbit/s with 1000 kbit steps. Total number of encodes is (1080 so far). For quality evaluation we chose 3 methods: PSNR-HVS-M and MS-SSIM, both measured by VQMT, and then VMAF. Power consumption was measured by Intel Power Gadget which provides cumulative energy consumption in mW h. Power consumption of GPU was measured by NVIDIA System Management Interface (NVIDIA SMI). Because this tool does not provide cumulative values, measurement was done 1 s intervals and then summed and converted to mW h.

Information about used software provides table 2. Information about used hardware provides table 3.

Table 2: Used software

Name	Version
Ubuntu GNOME	16.04.1 LTS
Mesa	13.0
Nvidia driver	375
FFmpeg	
x264	
x265	
OpenH264	
libtheora	
libvpx	
NVIDIA SMI	
Intel Power Gadget	
VMAF Development Kit	
VQMT	

Table 3: Used hardware

Part	Specification
CPU	Intel Core i5-4570@3.2 GHz
RAM	DDR3 32 GB
GPU	Nvidia 960 GTX 4 GB
SSD	Samsung EVO 850 250 GB

3 Results and Analysis

3.1 h264_nvenc

aklsmdalkdmaskldmasldm

3.2 x264

jansdkansdkjnkasjn

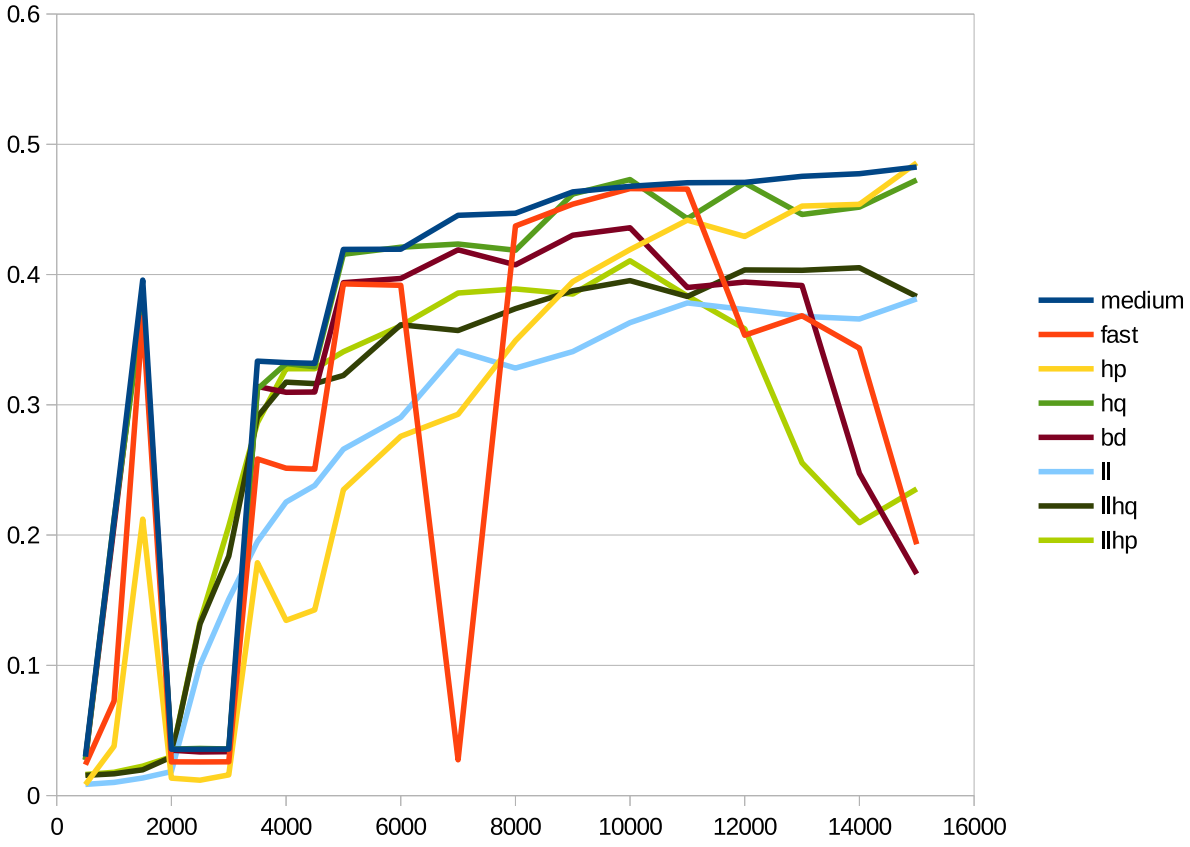

Figure 1: h264_nvenc PCR for old_town_cross

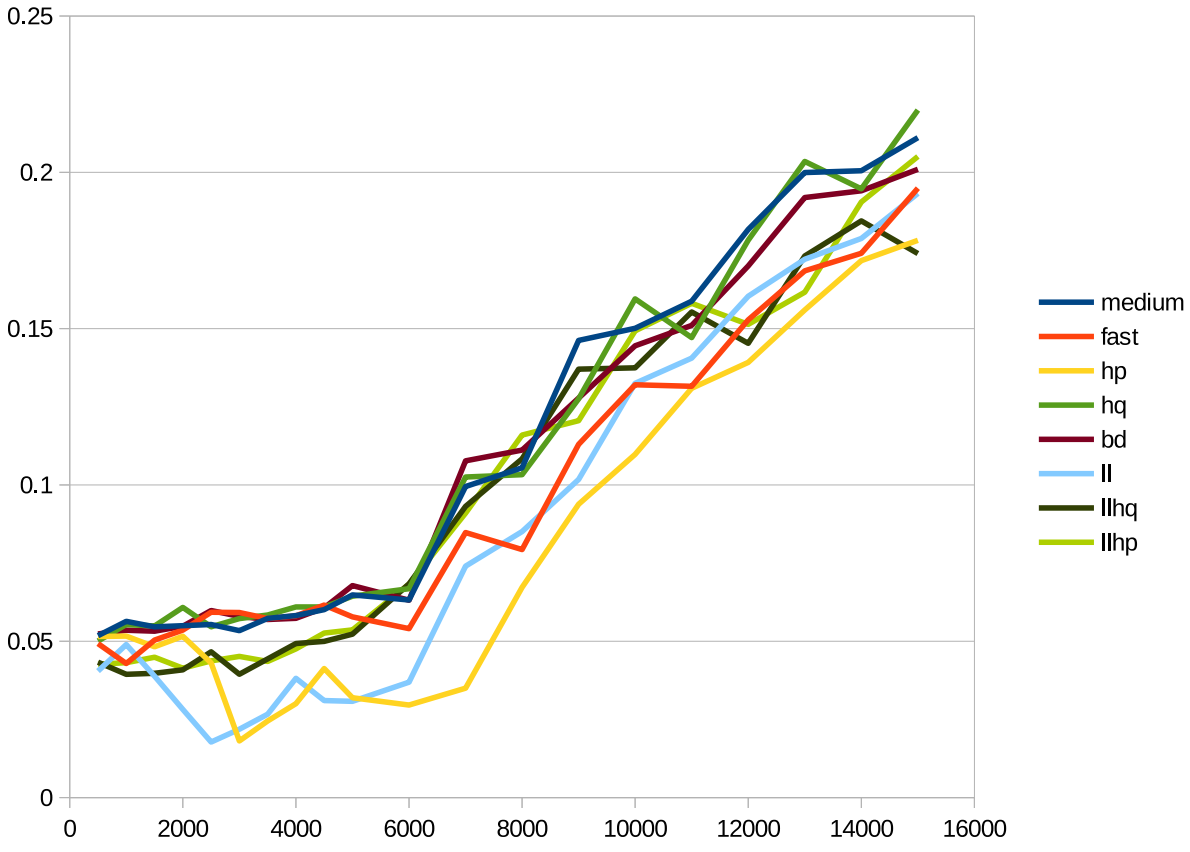

Figure 2: h264_nvenc PCR for crowd_run

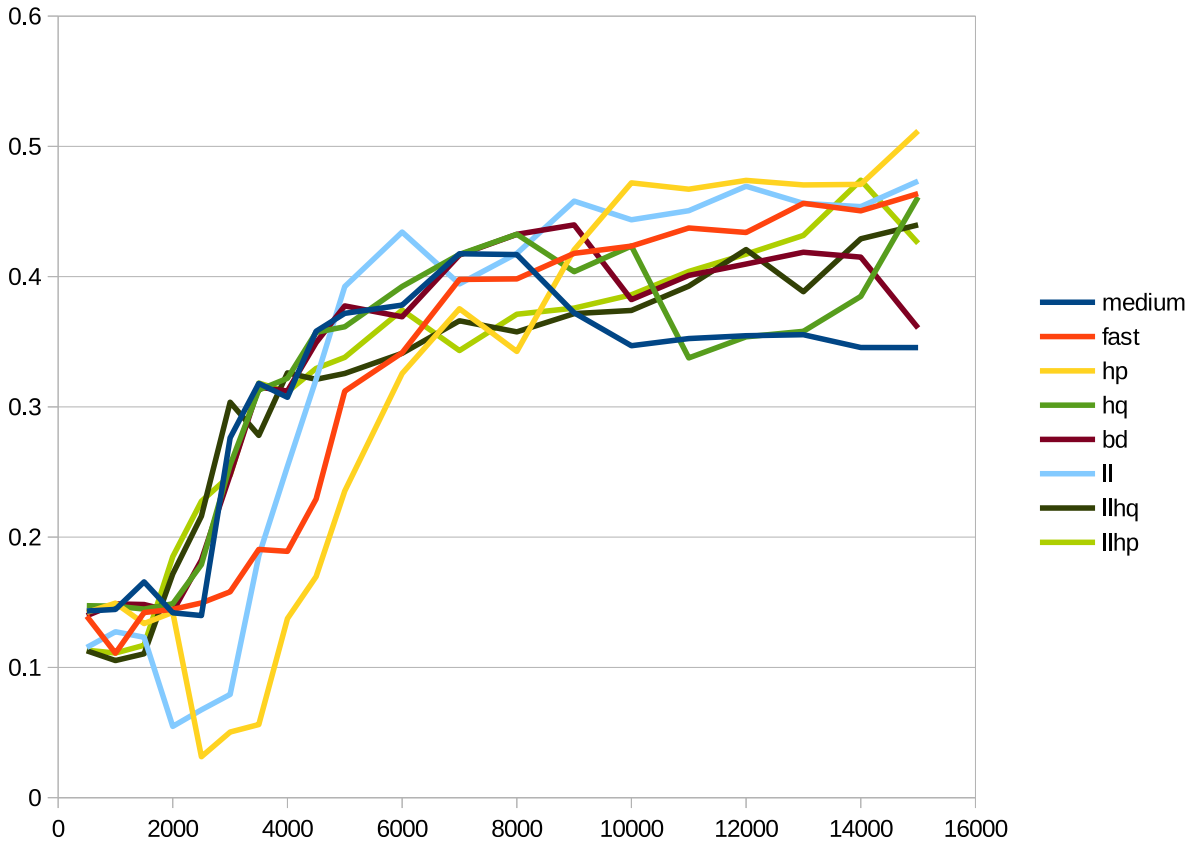

Figure 3: h264_nvenc PCR for sintel

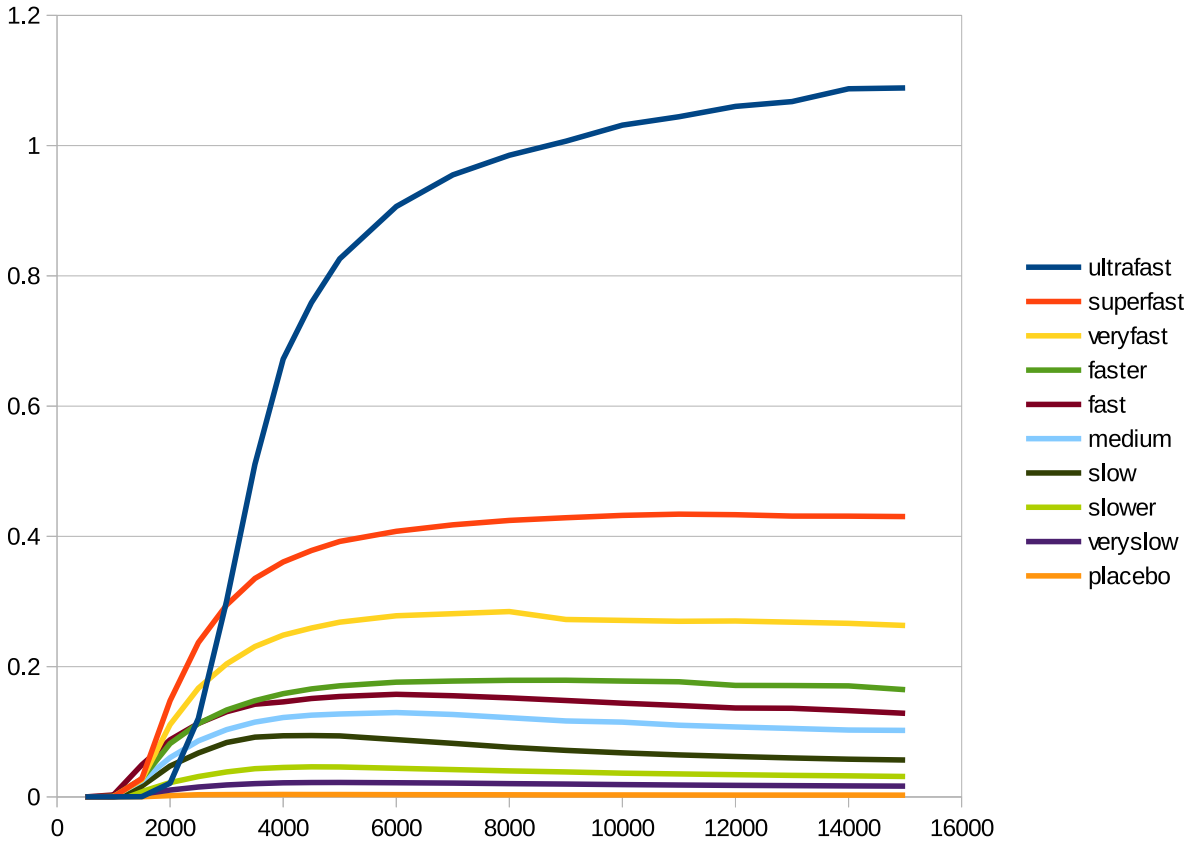

Figure 4: x264 PCR for old_town_cross

4 Discussion

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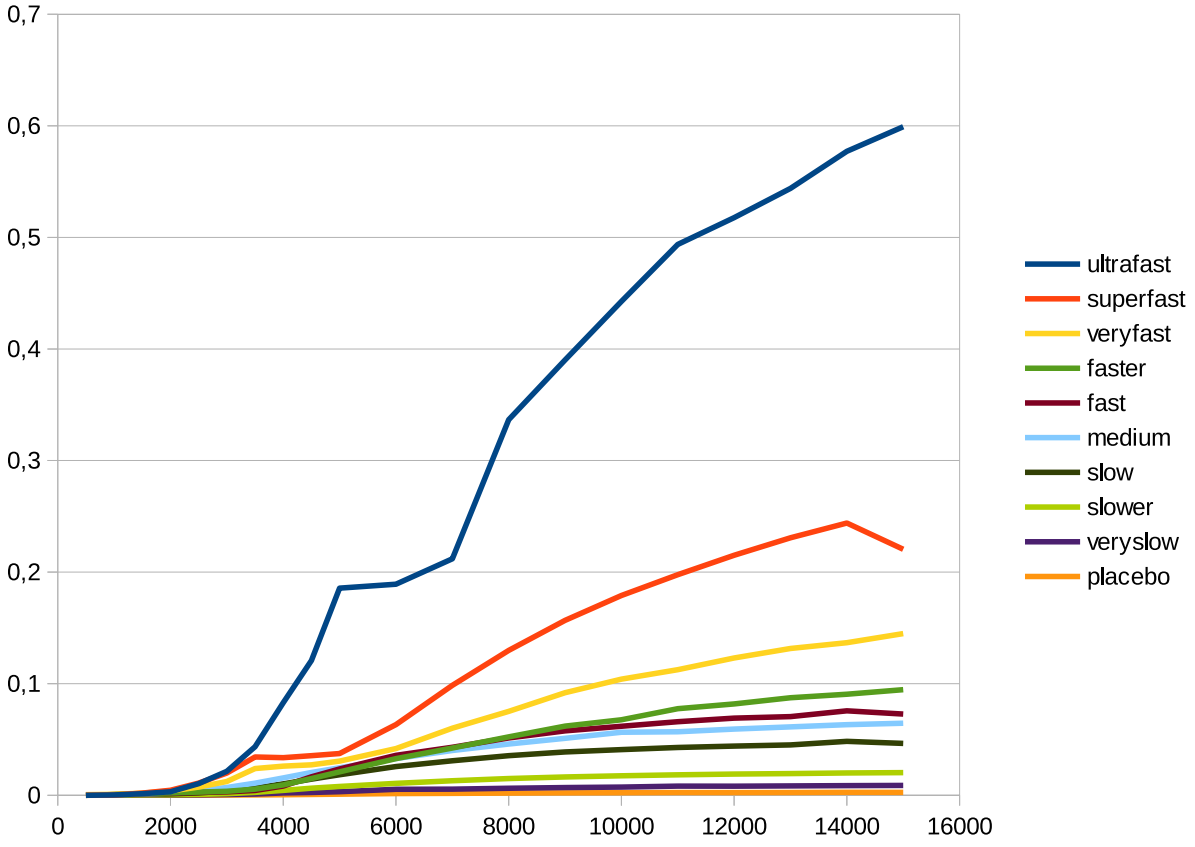

Figure 5: x264 PCR for crowd_run

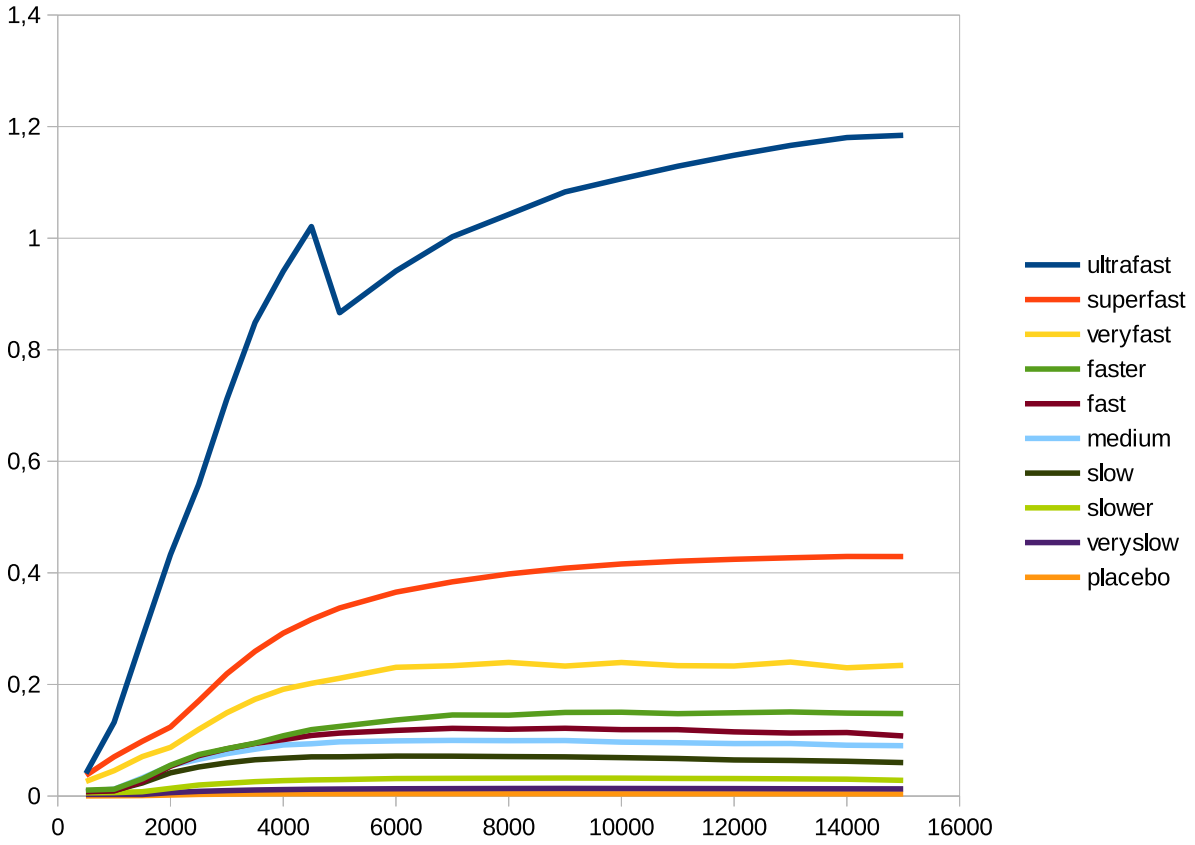

Figure 6: x264 PCR for sintel

References

[1] Intel Corporation. *Intel QuickSync Video and FFmpeg. Installation and Validation*. 24th Dec. 2015. URL: http://www.intel.ie/content/dam/www/public/emea/xe/en/

documents/white-papers/quicksync-video-ffmpeg-install-valid.pdf (visited on 13/10/2016).

[2] NVIDIA Corporation. *FFMPEG WITH NVIDIA ACCELERATION ON UBUNTU LINUX. Installation and User Guide*. 9th Oct. 2015. URL: http://developer.download.nvidia.com/compute/redist/ffmpeg/1511-patch/FFMPEG-with-NVIDIA-Acceleration-on-Ubuntu_UG_v01.pdf (visited on 13/10/2016).

A Annex