



## Fastvideo, LLC

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### Introduction

We have done testing for our SDK to demonstrate current performance results on NVIDIA server, desktop and mobile GPUs for frequently used algorithms, image resolutions 2K/4K and bit depths.

### Hardware and Software requirements (OS, PC, GPU, etc.)

- OS: Windows-7/8/10 (64-bit), Linux (64-bit), Linux4Tegra
- NVIDIA GPU: Server (Tesla, Quadro), Desktop (GeForce GTX/GT), Laptop (GeForce GT), Mobile (Tegra K1/X1/X2/Xavier)
- CUDA-9.2 (64-bit)

### Benchmarks for Fastvideo Image & Video Processing SDK (ms)

	<i>GeForce 1080</i>	<i>Quadro P6000</i>	<i>Tegra X1 / X2 / Xavier</i>
<b>JPEG Encoder</b>			
2K gray (8-bit, q=90%)	0.216	0.11	1.5 / 1.2 / 0.74
2K (24-bit, q=90%, 4:2:0)	0.36	0.17	2.4 / 2.0 / 1.1
2K (24-bit, q=90%, 4:4:4)	0.40	0.21	3.7 / 3.1 / 1.45
4K gray (8-bit, q=90%)	0.55	0.35	6.3 / 5.0 / 2.4
4K (24-bit, q=90%, 4:2:0)	0.78	0.51	9.4 / 7.9 / 3.7
4K (24-bit, q=90%, 4:4:4)	1.12	0.74	14.9 / 12.5 / 5.7
4K gray (12-bit, q=90%)	0.83	0.54	11.2 / 8.5 / 4.2
4K (36-bit, q=90%, 4:2:0)	1.22	0.82	17.9 / 13.4 / 6.2
4K (36-bit, q=90%, 4:4:4)	1.90	1.32	28.6 / 22.4 / 10.1
<b>JPEG Decoder</b>			
2K gray (8-bit, q = 90%)	0.55	0.40	3.1 / 2.5 / 1.4
2K (24-bit, q = 90%, 4:2:0)	1.36	1.20	6.2 / 5.3 / 2.4
2K (24-bit, q = 90%, 4:4:4)	1.02	0.73	8.3 / 6.1 / 2.4
4K gray (8-bit, q = 90%)	1.52	1.28	11.9 / 9.1 / 3.9
4K (24-bit, q = 90%, 4:2:0)	2.61	2.12	27.1 / 19.5 / 7.2
4K (24-bit, q = 90%, 4:4:4)	2.78	2.28	32.6 / 21.4 / 7.8

<b>Resizer (Lanczos3 algorithm)</b>			
2K (color, 24-bit, downscale = 2.0)	0.38	0.35	5.6 / 4.9 / 2.9
2K (color, 24-bit, downscale to 1919x1079)	0.66	0.60	10.6 / 9.9 / 4.7
4K (color, 24-bit, downscale = 2.0)	1.21	1.01	20.4 / 17.7 / 10.3
4K (color, 24-bit, downscale to 3839x2159)	2.34	1.93	39.5 / 35.6 / 17.5
<b>Demoaic HQLI</b>			
2K (8-bit, RGGB)	0.065	0.04	0.7 / 0.56 / 0.28
2K (16-bit, RGGB)	0.13	0.06	1.0 / 0.66 / 0.51
4K (8-bit, RGGB)	0.23	0.15	2.7 / 2.15 / 1.26
4K (16-bit, RGGB)	0.46	0.20	3.9 / 2.6 / 2.0
<b>Demoaic DFPD</b>			
2K (8-bit, RGGB)	0.17	0.13	2.7 / 2.3 / 0.84
2K (16-bit, RGGB)	0.24	0.13	2.5 / 1.9 / 1.12
4K (8-bit, RGGB)	0.61	0.45	11.1 / 9.6 / 3.1
4K (16-bit, RGGB)	0.81	0.45	9.6 / 7.5 / 4.1
<b>Demoaic MG</b>			
2K (16-bit, RGGB)	0.65	0.47	8.2 / 6.5 / 3.1
4K (16-bit, RGGB)	2.04	1.38	33.4 / 26.5 / 11.4
<b>Denoiser with CDF 9/7 wavelet</b>			
2K (gray, 8-bit)	0.61	0.37	5.5 / 4.4 / 2.6
2K (color, 24-bit)	1.78	1.07	15.2 / 11.3 / 7.5
4K (gray, 8-bit)	1.96	1.21	21 / 16.7 / 8.3
4K (color, 24-bit)	5.85	3.47	59 / 43 / 24.3
<b>JPEG2000 Encoder (single image mode, sampling 4:4:4)</b>			
2K (24-bit, lossy, cb 32x32, cr = 12)	7.0	6.8	70 / 57 / 18.7
2K (24-bit, lossless, cb 32x32)	10.2	10.3	180 / 118 / 40
4K (24-bit, lossy, cb 32x32, cr = 12)	19.2	17.45	- / 184 / 76
4K (24-bit, lossless, cb 32x32)	34.9	30.7	- / 442 / 153
<b>JPEG2000 Encoder (multithread-batch mode, sampling 4:4:4)</b>			
2K (24-bit, lossy, cb 32x32, cr = 12)	3.3	2.84	- / 54 / 17.6
4K (24-bit, lossy, cb 32x32, cr = 12)	12.0	10.3	- / 179 / 71

Time and performance measurements for Fastvideo SDK modules on NVIDIA GPUs for grayscale and color images don't take into account host I/O latency (image loading to RAM from HDD/SSD and saving back). We have presented timings for computations on GPU only. As soon as any image processing pipeline consists of series of such algorithms (SDK modules), it's a reasonable approach to measure only computation time, assuming that initial and final images reside in GPU memory.

## **Fastvideo SDK modules for CUDA image processing (ver. 0.13.1.8)**

- Image acquisition (from HDD/SSD/RAM, camera, grabber, byte array in CPU/GPU memory, OpenGL texture, PBO, etc.)
- Unpacking module for specific formats of RAW data
- Dark Frame Subtraction
- Shading Correction
- White balance (R, G1, G2, B)
- Exposure correction with LUT (Raw Curves and Levels for each channel)
- Raw Denoiser
- Debayer: HQLI (8/16-bit), DFPD (8/16-bit), MG (16-bit)
- Denoiser for processed data
- Color Correction with matrix profile
- Color Transforms: RGB-YCbCr-RGB, RGB-HSV-RGB, etc.
- Composite or per-color 8/10/12/14/16-bit 1D LUTs for tone mapping in RGB or HSV
- Gamma transform (composite or per-color component)
- 3D LUTs for RGB or HSV
- DCP profile support
- Histograms for RAW and processed data
- RGB Parade (waveform monitor)
- Rotation (90/180/270 degrees), flip/flop, arbitrary angle
- Resize (downsampling and upsampling)
- Remap (shift, resize, rotate, perspective, undistortion, projections, etc.)
- LCP support
- Unsharp Mask
- Realtime output via OpenGL
- JPEG Codec (Baseline JPEG only: 8/24-bit, Huffman encoding/decoding)
- MJPEG input or output
- 12-bit JPEG Encoder
- Raw Bayer Codec (lossy compression and decompression)
- JPEG2000 Codec (8-16 bits per channel)
- Stream-per-thread option to overlap copy and computations
- Other: trace, multiplexor, time measurements, HD-SDI support, multiple camera

## **Demo software for Image & Video Processing on CUDA**

One can download demo applications for JPEG Codec, JPEG2000 Codec, Debayer and Resizer from [www.fastcompression.com/download/download.htm](http://www.fastcompression.com/download/download.htm). These are high performance applications with command-line interface to evaluate both performance and quality of GPU-based Image & Video Processing SDK. Other sample applications could be found in the SDK.

The latest version of **Fast CinemaDNG Processor** is available from [www.fastcinemadng.com](http://www.fastcinemadng.com)

The latest release of Fastvideo SDK is available upon request.

## **Fastvideo Roadmap 2019**

- Fast 12-bit JPEG Decoder
- JPEG2000 Decoder optimization, MXF Player
- OpenGL output to 10-bit monitor
- Final release of Fast CinemaDNG Processor software