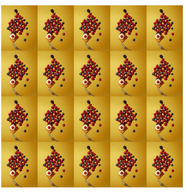
Image Greyscaler Benchmark Results

Input Image

- Image dimensions (pixels): 28000x28000 (FHD == 1920x1080)



- Image size (bytes): 119,828,615

Hardware/Software Specifications

Hardware

CPU

```
CPU:          Info: Quad Core
              model: Intel Core i7-4790K
              bits: 64
              type: MT MCP
              arch: Haswell
              rev: 3
              cache:
                 L2: 8 MiB
              flags: avx avx2 lm nx pae sse sse2 sse3 sse4_1 sse4_2 ssse3 vmx
              bogomips: 63873
              Speed: 4333 MHz
              min/max: 800/4400 MHz
              Core speeds (MHz):
                 1: 4333 2: 4043 3: 4323 4: 4126
                 5: 4346 6: 4282 7: 4277 8: 4339
```

RAM

```
Memory:       RAM: total: 11.54 GiB
              Array-1: capacity: 32 GiB
              slots: 4
              EC: None
              max-module-size: 8 GiB
              note: est.
              Device-1: ChannelA-DIMM0 size: No Module Installed
              Device-2: ChannelA-DIMM1 size: 4 GiB speed: 1333 MT/s type: DDR3
              Device-3: ChannelB-DIMM0 size: No Module Installed
              Device-4: ChannelB-DIMM1 size: 8 GiB speed: 1333 MT/s type: DDR3
```

CUDA

```
CUDA Device Query (Runtime API) version (CUDART static linking)


Detected 1 CUDA Capable device(s)

Device 0:
  CUDA Driver Version / Runtime Version          11.3 / 11.3
  CUDA Capability Major/Minor version number:    5.0
  Total amount of global memory:                 3998 MBytes (4192337920 bytes)
  (005) Multiprocessors, (128) CUDA Cores/MP:    640 CUDA Cores
  GPU Max Clock rate:                            1110 MHz (1.11 GHz)
  Memory Clock rate:                             2700 Mhz
  Memory Bus Width:                              128-bit
  L2 Cache Size:                                 2097152 bytes
  Total amount of constant memory:               65536 bytes
  Total amount of shared memory per block:       49152 bytes
  Total shared memory per multiprocessor:        65536 bytes
  Total number of registers available per block: 65536
  Warp size:                                     32
  Maximum number of threads per multiprocessor:  2048
  Maximum number of threads per block:           1024
  Max dimension size of a thread block (x,y,z): (1024, 1024, 64)
  Max dimension size of a grid size    (x,y,z): (2147483647, 65535, 65535)

deviceQuery
CUDA Driver = CUDART
CUDA Driver Version = 11.3
CUDA Runtime Version = 11.3
NumDevs = 1
Result = PASS
```

Software

Operating System

```
Kernel: 5.12.14 x86_64
```

Compilers and Tools

- gcc:

  ```
  gcc (GCC) 11.1.0
  ```

- clang:

  ```
  clang version 12.0.1
  Target: x86_64-pc-linux-gnu
  Thread model: posix
  ```

- cmake:

  ```
  cmake version 3.20.5
  ```

Algorithm

The overall algorithm of all implementation models is as the following:

1. Read the input image
2. Load the entire image into memory (RAM or GPU DRAM)
3. Start timer
4. Transform image (launch threads in multi-threaded implementation)
5. Gather results
6. Stop timer
7. Print elapsed execution time
8. Write results to output image file
9. Clean any allocated memory

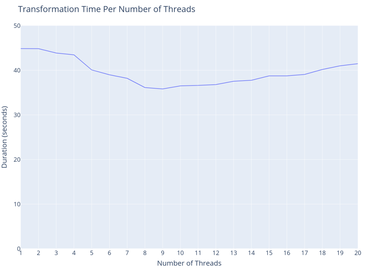
Limitations

Current implementation uses `libjpeg` for reading, manipulating, and writing jpeg images.

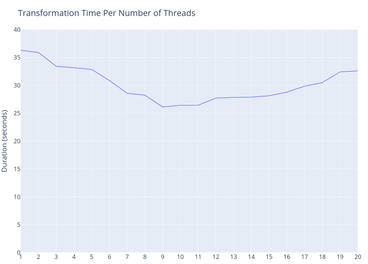
Results

Results are average of *only processing time* of executing the same implementation with different configuration parameters 2000 times:

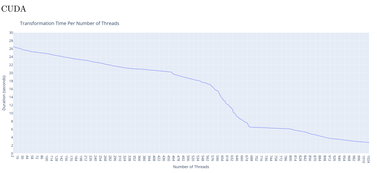
- OpenMP



- pthread



- CUDA



Speedup

The following is the best execution time of different parallelism model implementations compared in one view (+ single-threaded serial execution):