Don Pham (phamd)
Ryan Davis (davisr3)

Analysis Report

**Data**
Below is the table with our findings. The units are in seconds for all tests. The data was obtained by logging the “real” value from the time command. The average value of 2 tests was recorded for every test case, and those values was used for the speedup and efficiency tables.

The tests were interleaved to leave at least 10 minutes between each test for the same case.

| | | **Image Size** | | | |
|---|---|---|---|---|---|
| | **Cores** | **1920x1080** | **2560x1600** | **2880x2560** | **3840x2160** |
| **Radius 0** | **1** | 6.8645 | 12.9965 | 22.9335 | 25.8835 |
| | **2** | 3.7625 | 6.8825 | 11.903 | 13.317 |
| | **4** | 2.2145 | 3.82 | 6.3975 | 7.125 |
| | **8** | 1.3825 | 2.4145 | 3.63 | 4.017 |
| | **16** | 1.1455 | 1.444 | 2.2455 | 2.487 |
| | **32** | 0.933 | 1.001 | 1.305 | 1.8615 |
| **Radius 10** | **1** | 983.347 | 1751.091 | 2216.57 | 3944.869 |
| | **2** | 493.486 | 875.295 | 1108.487 | 1972.151 |
| | **4** | 247.444 | 440.055 | 556.795 | 990.075 |
| | **8** | 124.121 | 220.292 | 278.027 | 495.305 |
| | **16** | 66.16 | 110.541 | 139.626 | 248.061 |
| | **32** | 49.995 | 55.566 | 92.3345 | 146.4735 |
| **Radius 20** | **32** | 177.356 | 207.712 | 332.6395 | 531.9305 |
| **Radius 40** | **32** | 623.852 | 816.765 | 1212.836 | 1985.175 |

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At the time of testing, mpirun was not working. The serial execution time was instead recorded by running the CUDA code with one process only.

| Speedup | | | | | |
|---|---|---|---|---|---|
| | **Cores** | **1920x1080** | **2560x1600** | **2880x2560** | **3840x2160** |
| **Radius 0** | **1** | 1 | 1 | 1 | 1 |
| | **2** | 1.824452 | 1.88833999 | 1.926699 | 1.943643 |
| | **4** | 3.099797 | 3.40222513 | 3.58476 | 3.632772 |
| | **8** | 4.96528 | 5.38268793 | 6.317769 | 6.44349 |
| | **16** | 5.99258 | 9.00034626 | 10.21309 | 10.40752 |
| | **32** | 7.357449 | 12.9835165 | 17.57356 | 13.90465 |
| **Radius 10** | **1** | 1 | 1 | 1 | 1 |
| | **2** | 1.992654 | 2.00057238 | 1.999636 | 2.000288 |
| | **4** | 3.974018 | 3.97925487 | 3.980945 | 3.984414 |
| | **8** | 7.922487 | 7.94895412 | 7.972499 | 7.964525 |
| | **16** | 14.86317 | 15.8410997 | 15.87505 | 15.90282 |
| | **32** | 19.66537 | 31.5159821 | 23.99976 | 26.92982 |

| Efficiency | | | | | |
|---|---|---|---|---|---|
| | **Cores** | **1920x1080** | **2560x1600** | **2880x2560** | **3840x2160** |
| **Radius 0** | **1** | 1 | 1 | 1 | 1 |
| | **2** | 0.912226 | 0.94417 | 0.96335 | 0.971822 |
| | **4** | 0.774949 | 0.85055628 | 0.89619 | 0.908193 |
| | **8** | 0.62066 | 0.67283599 | 0.789721 | 0.805436 |
| | **16** | 0.374536 | 0.56252164 | 0.638318 | 0.65047 |
| | **32** | 0.22992 | 0.40573489 | 0.549174 | 0.43452 |
| **Radius 10** | **1** | 1 | 1 | 1 | 1 |
| | **2** | 0.996327 | 1.00028619 | 0.999818 | 1.000144 |
| | **4** | 0.993505 | 0.99481372 | 0.995236 | 0.996104 |
| | **8** | 0.990311 | 0.99361926 | 0.996562 | 0.995566 |
| | **16** | 0.928948 | 0.99006873 | 0.992191 | 0.993926 |
| | **32** | 0.614543 | 0.98487444 | 0.749993 | 0.841557 |

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**Discussion**

There was very little variation between the runtimes of subsequent tests of one condition.

As the number of processes increased, performance improved massively. The speedup was far more than the speedups seen when using MPI.

The work done by each process when the radius was 0 was too trivial to make proper conclusions about scalability from the efficiency table. However, the efficiency table with radius 10 definitely shows the program to be both strongly and weakly scalable. (The efficiency stays constant when the problem size stays constant, and it stays constant when the problem size increases at the same rate as the problem size.) There are outliers in the 32 processor row for 1k, 3k, and 4k, but apart from that, the efficiency stays very close to 1 for the entire table.