Programming parallel computers: Exercise 5

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1 MF4

Median filtering GPU naive implementation without cache blocking. Table-1 shows the comparision of performance with MF2 with 8-cores. Figure-1 is the plot ofperformance comparision of MF4 with MF2.

Using naive implementation each output pixel is a taken as a thread, each thread calculates the median per pixel. Threads are grouped into blocks to make a grid with BLOCKDIM_X wrt x-axis and BLOCKDIM_Y wrt y-axis. Quick-select algorithm is used to find the median as sorting the values to get median produces worst performance.

2 CP9

CP9 is the GPU implementation of correlated pairs with cache blocking using shared memory. CP9 is an improvement over CP8 naive implementation. Table2 shows the performance statistics of CP9 and Figure 2 is the plot of performance statistics of CP9 in comparision with CP4.

The efficiency of the algorithm depends in the matrix multiplication which is $O(n^3)$. The matrix is divided into BLOCKDIM_X rows for matrix1 and BLOCKDIM_Y rows for matrix2. In total it produces BLOCKDIM_X*BLOCKDIM_Y threads per block and in each block the rows are again sub divided into TILE_WIDTH columns, and the resultant sub-matrix is copied to shared memory and multiplication is done in with the sub-matrices. The performance can be even increased by doing the normalisation on GPU. The current implementation does the normalisation on GPU. To exploit the symmetry of the matrix, only blocks which are relevant are calculated (blockIdx.x ¡ blockIdx.y) and inside the block (row ¡ column) can also be ignored.

	ny	nx	window size	MF4-GPU naive	MF2-CPU 8 threads
mf	100	100	1	0.062	0.001
mf	100	100	2	0.056	0.009
mf	100	100	5	0.064	0.010
mf	100	100	10	0.159	0.016
mf	200	200	1	0.112	0.003
mf	200	200	2	0.104	0.010
mf	200	200	5	0.139	0.021
mf	200	200	10	0.238	0.031
mf	500	500	1	0.391	0.008
mf	500	500	2	0.457	0.017
mf	500	500	5	0.488	0.056
mf	500	500	10	1.004	0.170
mf	1000	1000	1	1.410	0.027
mf	1000	1000	2	1.755	0.062
mf	1000	1000	5	1.769	0.229
mf	1000	1000	10	3.695	0.671
mf	2000	2000	1	5.507	0.099
mf	2000	2000	2	6.846	0.224
mf	2000	2000	5	6.897	0.863
mf	2000	2000	10	14.563	2.713

Table 1: MF4 runtime benchmark

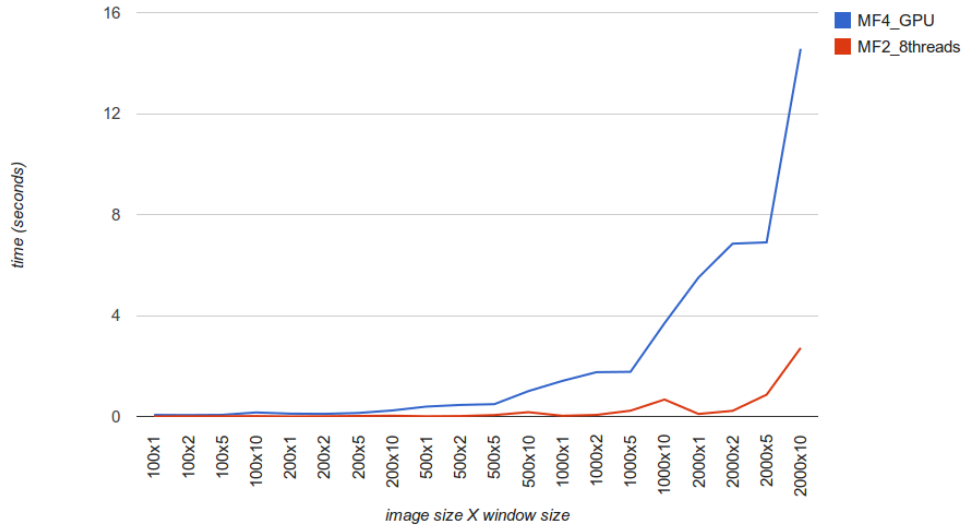

Figure 1: MF4 comparision with MF2-8threads

	nx	ny	cp9	cp8	cp4
cp	10	10	0.001	0.044	0
cp	100	100	0.001	0.045	0
cp	500	500	0.009	0.070	0.006
cp	1000	1000	0.049	0.256	0.024
cp	2000	2000	0.296	1.740	0.162
cp	4000	4000	2.105	13.513	1.557

Table 2: CP9 performance statistics comparision with CP4 and CP8

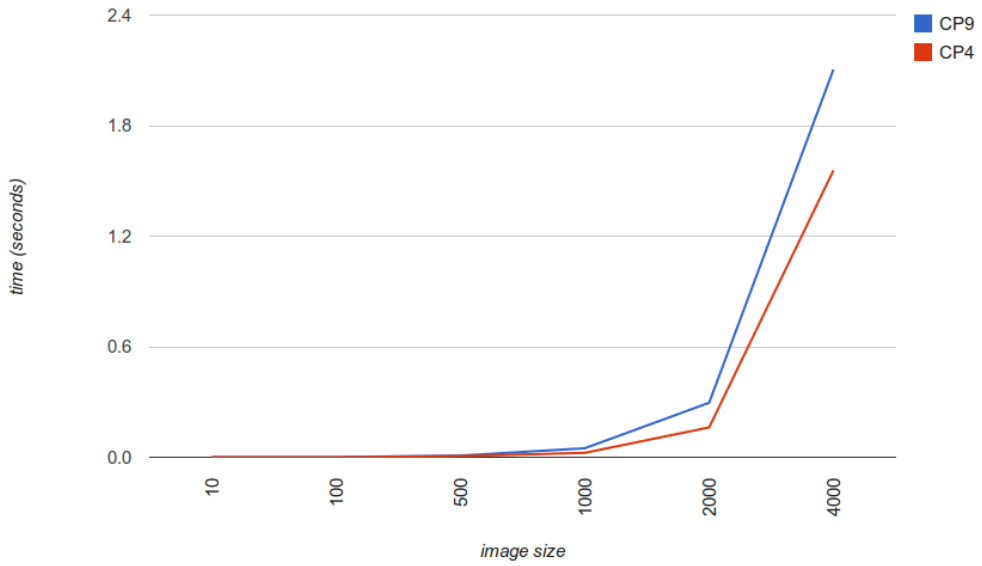

Figure 2: CP9 performance comparision with CP4

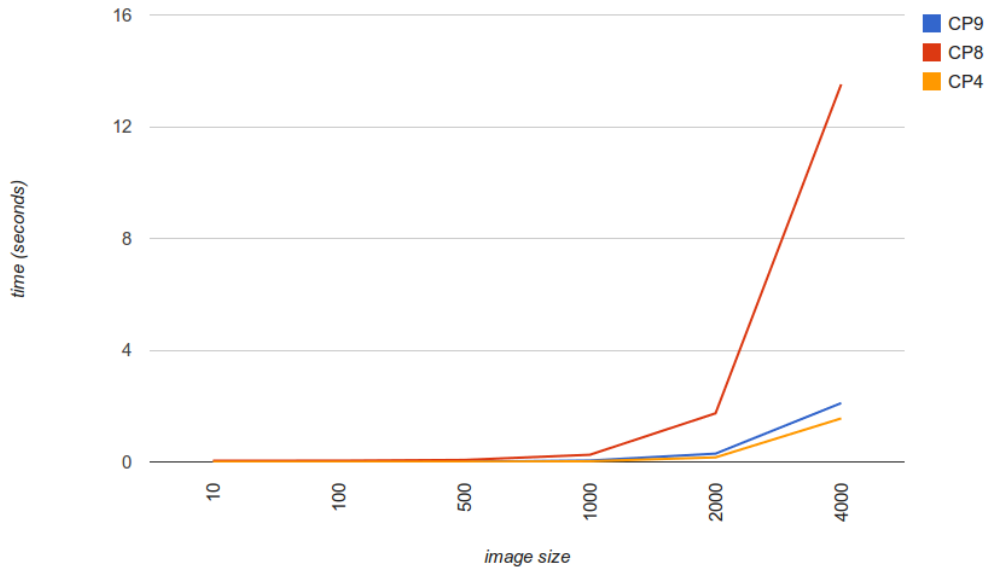

Figure 3: CP9 performance comparision with CP8 and CP4