

**Introduction to CUDA Parallel Programming      Homework Assignment 3**  
**Due 2020/04/07**

1. Use the sample codes in [twqcd135:/home/cuda\\_lecture/laplaceTex](http://twqcd135:/home/cuda_lecture/laplaceTex) to test run the following lattice sizes: 32 x 32, 64 x 64, 128 x 128, 256 x 256, and each with the block sizes: (4, 4), (8, 8), (16, 16), (32, 32). Compare the performances of CPU, GPU using device memory, and GPU using texture, and discuss your results.

2. Solve the Laplace equation on the 512 x 512 square lattice with the boundary conditions:

$\phi = +1$ , on the top boundary

$\phi = -1$ , on the left boundary

$\phi = -2$ , on the right boundary

$\phi = +5$ , on the bottom boundary

Use the linux command “diff” to compare the results of CPU, GPU using device memory, and GPU using texture. Find the optimal block sizes for the CUDA codes with and without using texture.

3. Develop a CUDA code (with and without using texture) for solving the Laplace equation on a 3D lattice with boundary conditions. To verify your code, you can use a small lattice, say, 4 x 4 x 4 lattice, with the simple boundary conditions

$\phi = 1$ , on the top surface

$\phi = 0$ , on all other surfaces

Then compare CPU and GPU results.

As usual, your homework report should include your source codes, results, and discussions. The discussion file should be prepared with a typesetting system, e.g., LaTeX, Word, etc., and it is converted to a PDF file. All files should be zipped into one gzipped tar file, with a file name containing your student number and the problem set number (e.g., r05202043\_ps3.tar.gz). **Please send your homework from your NTU email account to [twchiu@phys.ntu.edu.tw](mailto:twchiu@phys.ntu.edu.tw)** before 24:00 of the due date.