Vienna University of Technology

360.252 Computational Science on Many Core Architectures

Institute for Microelectronics

Exercise 6

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Abstract

Here documented the results of exercise 6.

Contents

1 Task1 : Inclusive and Exclusie Scan (0/4 Points)

1.1 Describe the Workings of the Kernels (1 Point)

wtf is actually going on: scan kernel 1: 256x256 scan within each block and calculate/reduce there calculate workperthread and use according indices of the vector do the reduction: we do inclusive reduction -¿ then have to use... fancy ternary oparator to write 0 first -¿ threadIdx == 0 -¿ write 0, all thread write values, except last one
write back result in vector
scan kernel 2: (1x 256) add all the results of the kernels 1 block, 1 thread per block from (1) reduction over all the kernels write to output array accordingly again, s.t. we have exclusive scan -¿ 0 from threadIdx == 0, else write data at threadIdx-1
scan kernel 3: (256x256) shared variable offset all the 0 threads of all blocks from (1): set offset as carries value from blockIdx add the offset to each value between blockstart and blockstop we added all numbers together except the last one of the last thread

Algorithm `scan_kernel_1`

calculate `work_per_thread` from `N` ▷ Yields indices of vector chunk interfaces
scan within each block ▷ Done by reduction
Inclusive scan within each Buffer

`resetDeformation`
`initializeParameters` α, β, γ ▷ Aug. Lag. weights for $\mathrm{vol}(\Omega_\mathrm{i})$, $\mathrm{bc}_x(\Omega_\mathrm{i})$, $\mathrm{bc}_y(\Omega_\mathrm{i})$
for $\mathrm{i} < \mathrm{iter}_{\max}$ **do**
    SolveStokes() ▷ Solve Stokes on Ω_i
    SolveDeformationEquation() ▷ Solve Auxiliary Problem on Ω_i, yields X
    Evaluate `gfxbndnorm` $= ||X||_{\mathrm{L}^2(\Gamma_{\infty,\mathrm{i}})}$
    Evaluate `ScalingParamter` $= \frac{0.01}{||X||_{\mathrm{L}^2(\Omega_\mathrm{i})}}$
    if `gfxbndnorm` $< \varepsilon$ **then**
        Increase α, β, γ
        if `parametersTooBig` **then**
            `break`
        end if
    end if
    Set $\Omega_{i+1} = \Omega_i - X \cdot$ `ScalingParameter` ▷ Gradient Descent Step
end for

scan_kernel_2

scan_kernel_3

1.2 Provide an Implementation of Inclusive Scan (1 Point)

1.3 Modify Exclusive Scan Code to Convert to Inclusive scan (1 Point)

1.4 Compare Performances (1 Point)

2 Task 2: Finite Differences on the GPU (0/5 Points)

2.1 Kernel which counts/stores Number of Nonzero Entries for Rows of A (1 Point)

2.2 Row Offset Array of CSR Format (1 Point)

2.3 Kernel to Write Column Indices and Nonzero Matrix Values to CSR Arrays (1 Point)

2.4 Code to Allocate Necessary Arrays and call CG-Solver (1 Point)

2.5 Benchmark Code for Different System Sizes (1 Point)