

Αρχιτεκτονική Προηγμένων Υπολογιστών και Επιταχυντών Lab 2 Report

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Chapter 1

Software Emulation

1.1 Console Output

```
<terminated> (exit value: 0) SystemDebugger_lab2_system_lab2 [OpenCL] /mnt/data2/lab_fpga/student8/lab2/Emulation-SW/lab2 (12/19/25, 12:47 PM)
[Console output redirected to file:/mnt/data2/lab_fpga/student8/lab2/Emulation-SW/SystemDebugger_lab2_system_lab2.launch.log]
Found Platform
Platform Name: Xilinx
INFO: Reading /mnt/data2/lab_fpga/student8/lab2_system/Emulation-SW/binary_container_1.xclbin
Loading: '/mnt/data2/lab_fpga/student8/lab2_system/Emulation-SW/binary_container_1.xclbin'
Trying to program device[0]: xilinx_u200_gen3x16_xdma_2_202110_1
Kernel Name: imageDiffPosterize_1, CU Number: 0, Thread creation status: success
Device[0]: program successful!
Kernel Name: imageDiffPosterize_1, CU Number: 0, State: Start
Kernel Name: imageDiffPosterize_1, CU Number: 0, State: Running
Kernel Name: imageDiffPosterize_1, CU Number: 0, State: Idle
----- Key execution times -----
Allocate Memory in Host Memory : 0.410 ms
Fill the buffers : 0.168 ms
Run Software Reference : 0.334 ms
Load Binary File to Alveo U200 : 29.061 ms
Allocate Buffer in Global Memory : 0.219 ms
Set the Kernel Arguments : 0.040 ms
Copy input data to device global memory : 0.321 ms
Launch the Kernel : 0.423 ms
Copy Result from Device Global Memory to Host Local Memory : 2.255 ms
Compare the results of the Device to the simulation : 0.055 ms
TEST PASSED
device process sw_emu_device done
Kernel Name: imageDiffPosterize_1, CU Number: 0, Status: Shutdown
```

Figure 1.1: sw_emu

1.2 Kernels and Compute Units

Kernels & Compute Units										
Kernel Execution										
Kernel	Enqueues	Total Time (ms)	Min Time (ms)	Avg Time (ms)	Max Time (ms)					
⚡ imageDiffPosterize	1	0.959	0.959	0.959	0.959					
Top Kernel Execution										
Kernel	Kernel Instance Address	Context ID	Command Queue ID	Device	Start Time (ms)	Duration (ms)				
⚡ imageDiffPosterize	0x5575039e3120	0	0	xilinx_u200_gen3x16_xdma_2_202110_1-0	30.706	0.959				
Compute Unit Utilization										
Compute Unit	Kernel	Device	Calls	Dataflow Execution	Max Parallel Executions	Dataflow Acceleration	CU Device Utilization (%)	CU Kernel Utilization (%)	Total Time (ms)	Min Time (ms)
⌘ imageDiffPosterize_1	imageDiffPosterize	xilinx_u200_gen3x16_xdma_2_202110_1-0	1	No	0	1.000000x	92.894	92.894	0.891	0.891
									Max Time (ms)	Clock Freq (MHz)
									0.891	300.000

Figure 1.2: sw_kernels

1.3 Host Data Transfers

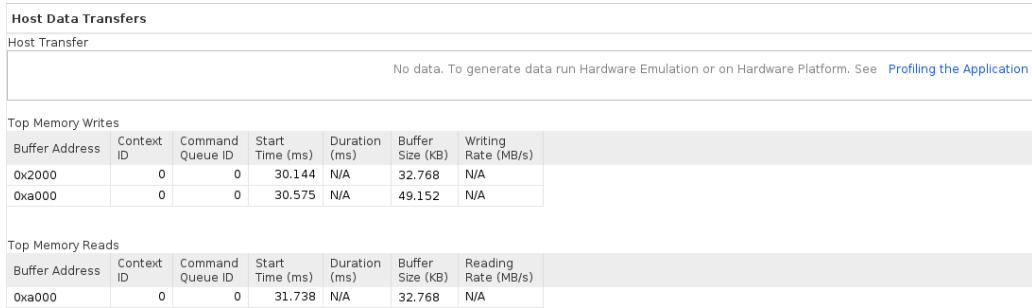


Figure 1.3: sw_data_trans

1.4 Timeline

Entire timeline:

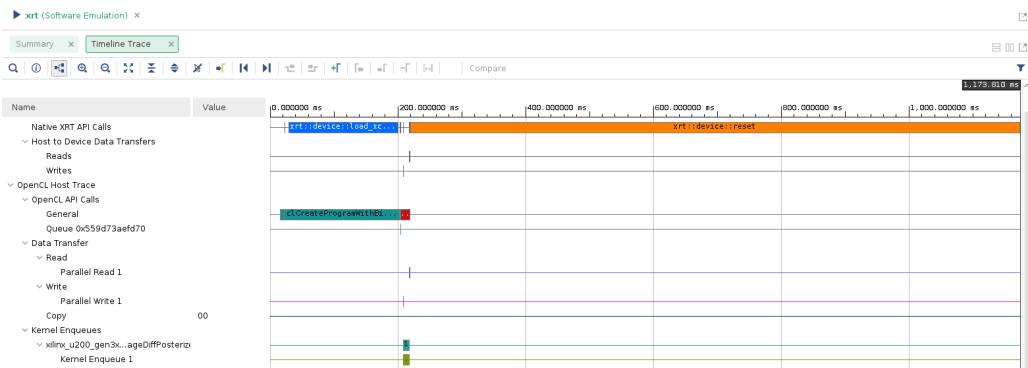


Figure 1.4: sw_timeline

Zoomed in:

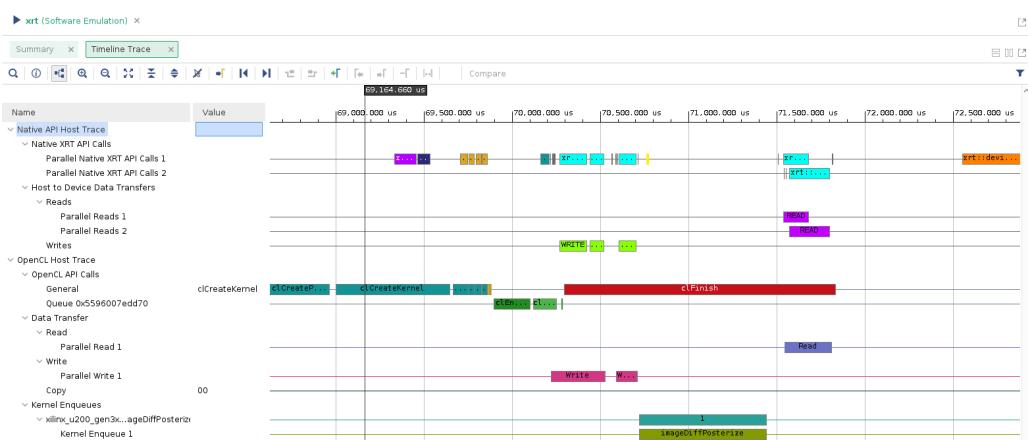


Figure 1.5: sw_timeline_zoom

Chapter 2

Hardware Emulation

2.1 Console Output

```
<terminated> (exit value: 0) SystemDebugger_lab2_system_1_lab2 [OpenCL] /mnt/data2/lab_fpga/student8/lab2/Emulation-HW/lab2 (12/19/25, 2:19 PM)
[Console output redirected to file:/mnt/data2/lab_fpga/student8/lab2/Emulation-HW/SystemDebugger_lab2_system_1_lab2.launch.log]
Found Platform
Platform Name: Xilinx
INFO: Reading /mnt/data2/lab_fpga/student8/lab2_system/Emulation-HW/binary_container_1.xclbin
Loading: '/mnt/data2/lab_fpga/student8/lab2_system/Emulation-HW/binary_container_1.xclbin'
Trying to program device[0]: xilinx_u200_gen3x16_xdma_2_202110_1
INFO: [HW-EMU 05] Path of the simulation directory : /mnt/data2/lab_fpga/student8/lab2/Emulation-HW/.run/15940/hw_em/device0/binary_0/be
INFO: [HW-EMU 01] Hardware emulation runs simulation underneath. Using a large data set will result in long simulation times. It is recom
configuring dataflow mode with ert polling
scheduler config ert(1), dataflow(1), slots(16), cudma(0), cuisr(0), cdma(0), cus(1)
Device[0]: program successful!
----- Key execution times -----
Allocate Memory in Host Memory : 0.528 ms
Fill the buffers : 0.268 ms
Run Software Reference : 17.265 ms
Load Binary File to Alveo U200 : 43448.398 ms
Allocate Buffer in Global Memory : 141.558 ms
Set the Kernel Arguments : 0.043 ms
Copy input data to device global memory : 0.305 ms
Launch the Kernel : 0.060 ms
Copy Result from Device Global Memory to Host Local Memory : 171210.906 ms
Compare the results of the Device to the simulation : 0.052 ms
TEST PASSED

socket connect is not established/broken
INFO: [HW-EMU 06-0] Waiting for the simulator process to exit
INFO: [HW-EMU 06-1] All the simulator processes exited successfully
INFO: [HW-EMU 07-0] Please refer the path "/mnt/data2/lab_fpga/student8/lab2/Emulation-HW/.run/15940/hw_em/device0/binary_0/beav_wavefo
```

Figure 2.1: hw_emu

2.2 Kernels and Compute Units

Kernels & Compute Units						
Kernel Execution (includes estimated device times)						
Kernel	Enqueues	Total Time (ms)	Min Time (ms)	Avg Time (ms)	Max Time (ms)	
imageDiffPosterize	1	0.513	0.513	0.513	0.513	
Top Kernel Execution						
Kernel	Kernel Instance Address	Context ID	Command Queue ID	Device	Start Time (ms)	Duration (ms)
imageDiffPosterize	0x559d10396e30	0	0	xilinx_u200_gen3x16_xdma_2_202110_1-0	0.039	0.513
Compute Unit Utilization (includes estimated device times)						
Compute Unit	Kernel	Device	Calls	Dataflow Execution	Max Parallel Executions	Dataflow Acceleration
imageDiffPosterize_1	imageDiffPosterize	xilinx_u200_gen3x16_xdma_2_202110_1-0	1	Yes	1	1.000000x
					98.061	98.061
			Total Time (ms)	Min Time (ms)	Avg Time (ms)	Max Clock Freq (MHz)
			0.503	0.503	0.503	300.000

Figure 2.2: hw_kernels

2.3 Host Data Transfers

Host Data Transfers								
Host Transfer								
Context: Number of Devices	Transfer Type	Number of Buffer Transfers		Transfer Rate (MB/s)	Avg Bandwidth Utilization (%)	Avg Size (KB)	Total Time (ms)	Avg Time (ms)
context0:1	READ	1		0.761	N/A	32.768	N/A	N/A
context0:1	WRITE	2		1.185	N/A	40.960	N/A	N/A

Top Memory Writes							
Buffer Address	Context ID	Command Queue ID	Start Time (ms)	Duration (ms)	Buffer Size (KB)	Writing Rate (MB/s)	
0x8000000000	0	0	43602.600	N/A	32.768	N/A	
0x800008000	0	0	43647.300	N/A	49.152	N/A	

Top Memory Reads							
Buffer Address	Context ID	Command Queue ID	Start Time (ms)	Duration (ms)	Buffer Size (KB)	Reading Rate (MB/s)	
0x800008000	0	0	214759.000	N/A	32.768	N/A	

Figure 2.3: hw_host_data_trans

2.4 Kernel Data Transfers

Kernel Data Transfers													
Kernel Transfer													
Compute Unit Port	Kernel Arguments	Device	Memory Resources	Transfer Type	Number of Transfers	Transfer Rate (MB/s)	BW Util wrt Current Port Config (%)	BW Util wrt Ideal Port Config (%)	Max BW on Current Port Config (MB/s)	Max BW on Ideal Port Config (MB/s)	Avg Size (KB)	Avg Latency (ns)	
imageDiffPosterize_1/m_axi_gmem	A[B][C].fil	xilinx_u200_gen3x16_xdma_2_202110_1-0	DDR[1]	WRITE	592	945.413	78.784	4.924	1200.000	1920.000	0.055	17.568	
imageDiffPosterize_1/m_axi_gmem	A[B][C].fil	xilinx_u200_gen3x16_xdma_2_202110_1-0	DDR[1]	READ	14487	848.548	70.712	4.420	1200.000	1920.000	0.006	3.987	

Top Kernel Transfer								
Compute Unit	Device	Number of Transfers	Avg Bytes per Transfer	Transfer Efficiency (%)	Total Data Transfer (MB)	Total Write (MB)	Total Read (MB)	Total Transfer Rate (MB/s)
imageDiffPosterize_1	xilinx_u200_gen3x16_xdma_2_202110_1-0	15079	8.000	0.196	0.121	0.033	0.088	872.740

Figure 2.4: hw_kernel_data_trans

2.5 Timeline

Entire timeline:

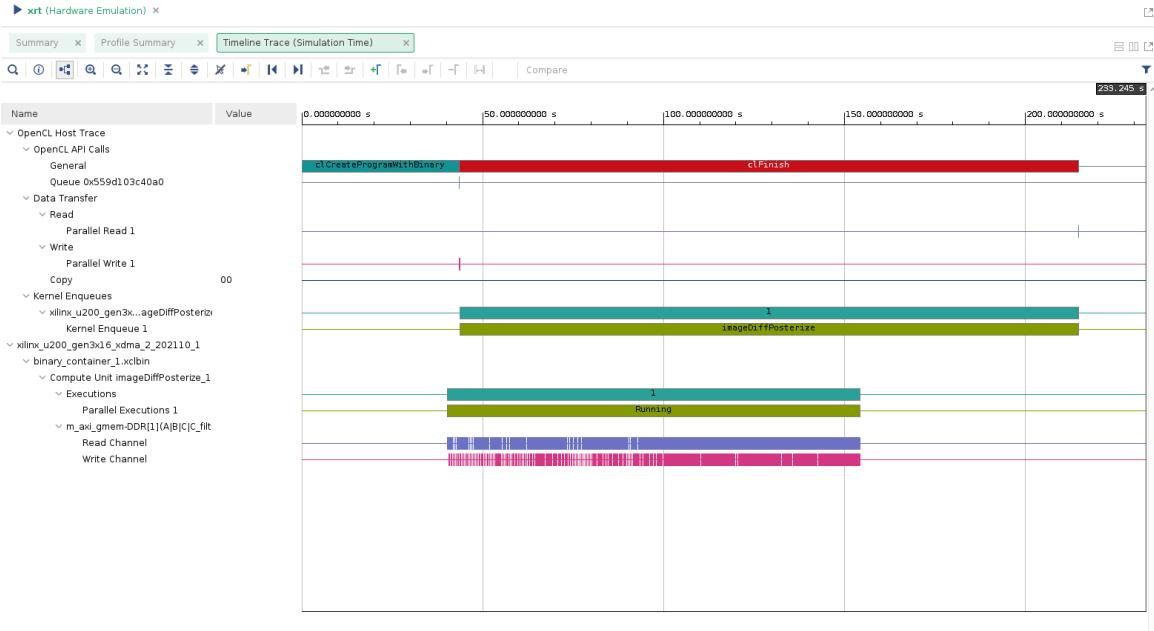


Figure 2.5: hw_timeline

Zoomed in at around 42 - 45 seconds:

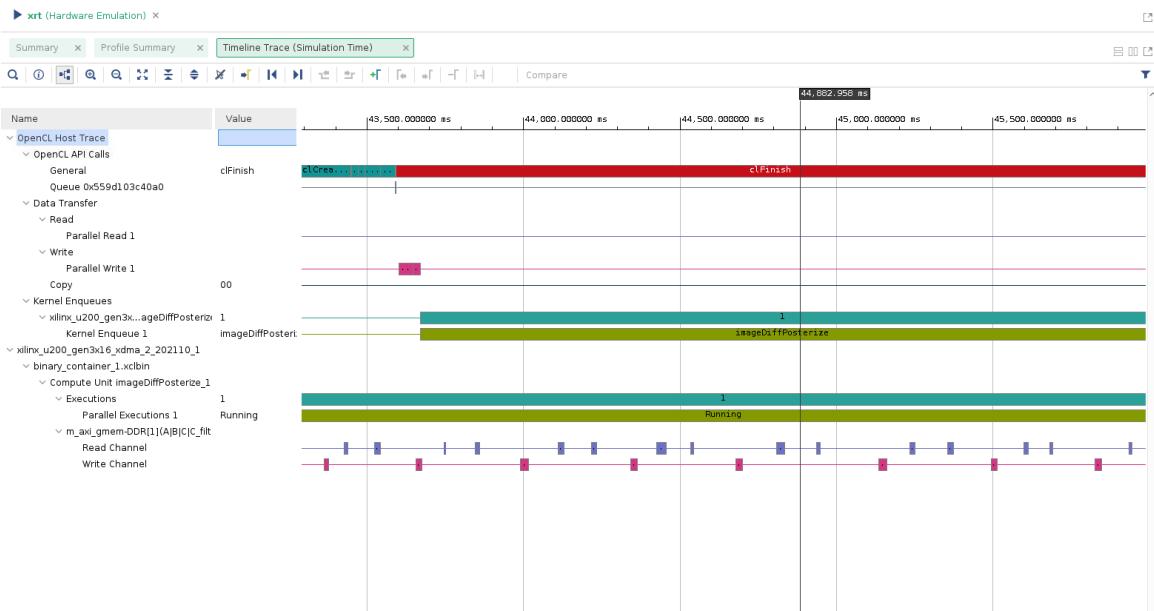


Figure 2.6: hw_timeline_zoom

2.6 API Calls

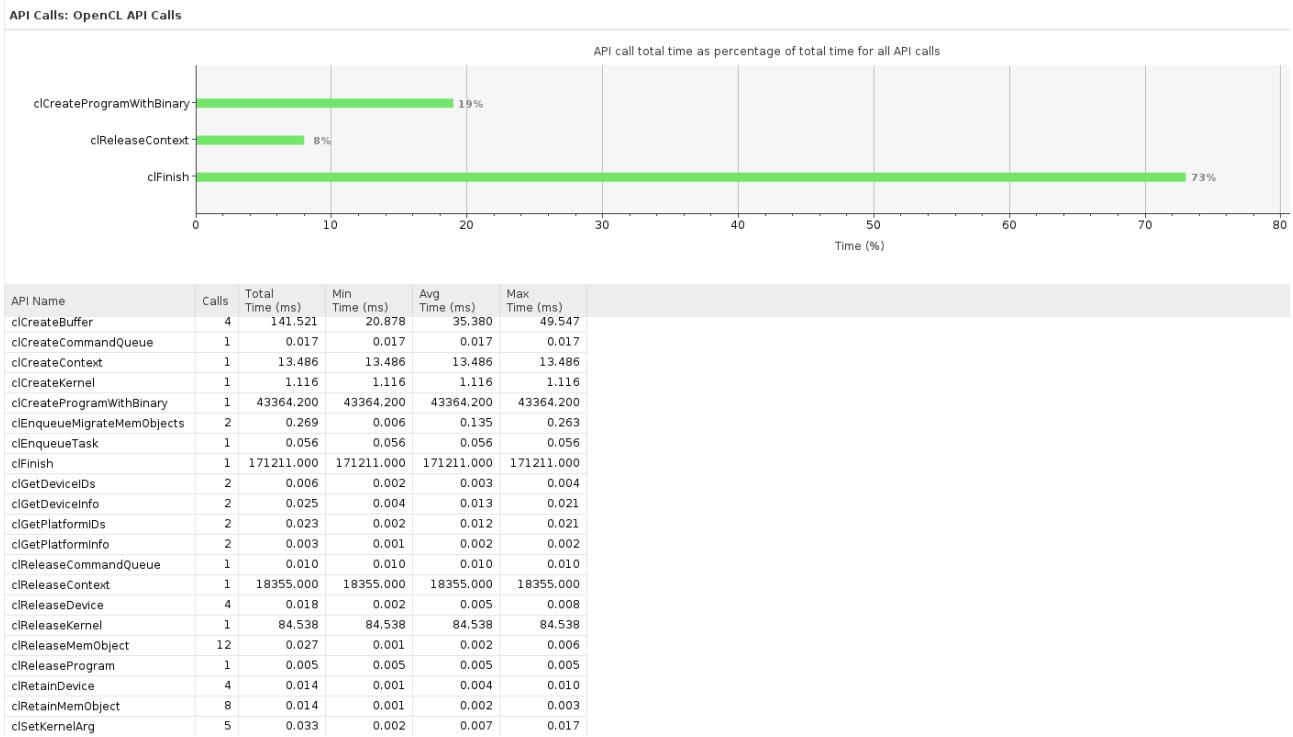


Figure 2.7: hw_api_calls

Chapter 3

Zip Contents

- lab2test.cpp
 - Locally run testing program with fully bufferized matrices.
- lab2test_easy.cpp
 - Locally run testing program, similar to lab2.cpp but doesn't utilize buffers for the calculation of **C_filter**.
- lab2.cpp
 - Final form of lab2's kernel. Run on Vitis.
- tb_lab2.cpp
 - The host which manages the lab2's kernel. Run on Vitis.