[Public]

Filter-2D accelerator design based on VCK5000

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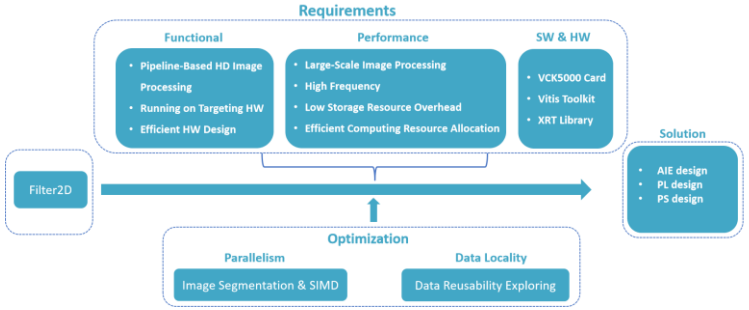
AMD

On board test by AMD VCK5000

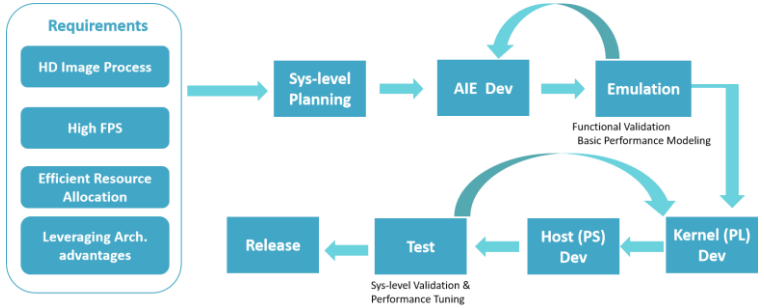
INTRODUCTION

The design requirements are initially determined, and system planning is carried out to enhance performance through two optimization methods: improving parallelism and enhancing data locality.

AIE is designed and developed, and its efficiency is validated through simulation testing. System-level testing is then conducted by combining PL and PS using the VCK5000 platform, ultimately resulting in a usable solution.

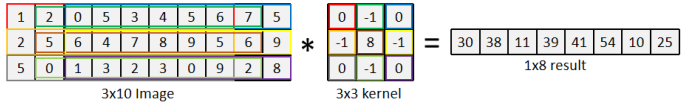


Overview of Problem Investigation

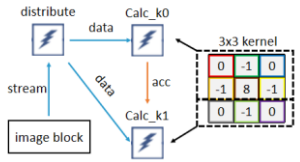


Overview of Development Process

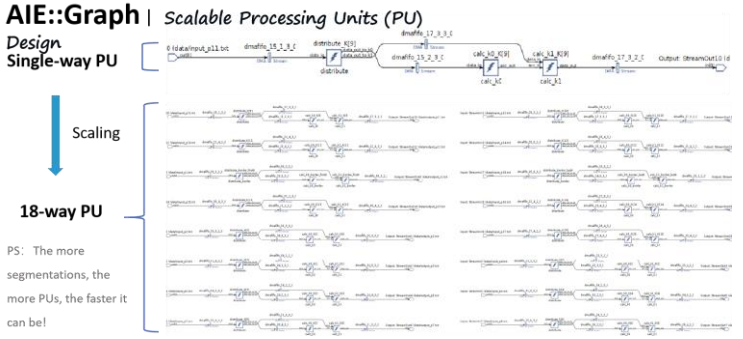
AIE::Vector | *Vector-Processor based on 8-way parallel computation for Int32 data type operations*



AIE::Kernel



AIE::Graph | *Scalable Processing Units (PU)*



Solution for AIE

During the calculation process, a vector processor is utilized for 8-way Int32 parallel operations. The computational load is allocated to two AIE kernels, and cascaded data streams are employed to transfer ACC between kernels, forming a pipeline within the processing unit.

To further enhance speed, the image is divided into multiple parts, and multiple processing units are utilized for parallel processing. In the current solution, 18 processing units have been employed.

CREATIVE DESING

RESULT

Benchmark	Requirements	Our Design
Image Size	High resolution	8K(7680x4320)
Frequency	High FPS	101.87FPS (Avg.)
Runtime	Efficient	9.82ms (Avg.)
Resource Allocation	Well-utilized	√
Pipeline Design	Well-designed	√

```
TEST PASSED !
VCK5000 filter2D take up 9.77466ms
PS filter2D take up 1348.27ms
Speedup ratio:137.935
Frames Per Second:102.305 FPS
write output.jpg image finish!
```

Overview of Result

The system effectively utilizes hardware resources and forms a pipeline processing method, capable of processing images with a resolution of up to 8K (7680x4320). The average processing time is 9.82 milliseconds, and the average frame rate is 101.87 FPS.

Summary |

AIE	PL	PS
• Centered around AIE • Fully utilize AIE features	• Provide data for AIE • JPEG image decoding	• Process control • Preprocessing • Post processing

Outlook |

Self-adaption	Other operators	Framework
• Further improving performance with adaptive wider resolution	• Developing More High Performance Operator Accelerators Based on AIE	• Propose an AIE centered accelerator development framework • **(Paper in submission)**

Summary and Outlook