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Compiling Image Processing Applications for Many-Core Accelerators

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Image Processing

image analysis: detect geometrical structures in an image
mathematical morphology: image analysis theory and technique based on lattice theory

Mathematical Morphology Base Operators

+ arithmetic operators
  + lUnary (point × parameter, 1 input image)
  + lBinary (point × point, 2 input images)
  + lLogical operators
  + lThreshold
  + lNeighbour selection: min/max/avg
  + reduction operators
  + lGlobal max/min/sum

Other operators:

− arithmetic operators
  + lUnary (pixel)
  + lBinary (pixel, 1 input image)
  + lUnary (pixel, 2 input images)
  + lLogical operators
  + lThreshold

Implement more complex algorithms: watershed, arrow, labelling, minima, ...

Improve data-parallelism to take better advantage of the current architecture

Other programming models:

− data-parallelization for compute-intensive operators
  + lGeneration of kernel-specific convolutions
  + lUnrolling of converging loops

Sigma-C

Sigma-C (FPGA/20 W)
MPPA-256 (Sigma-C/10 W)
Tesla C 2050 (OpenCL/240 W)
Quadro 600 (OpenCL/40 W)
SPoC (FPGA/25 W)

Future Work

− other programing models:
  + lOther alternative: OpenMP on compute clusters, communication library between clusters
  + lOpenCL via local memory pagination

− improve data-parallelism to take better advantage of the current architecture
  + lImplementation of more complex algorithms: watershed, arrow, labelling, minima, ...

Results: Execution Times and Energy Consumption (MPPA-256 = 1, lower is better)

Future Work

− Other programming models:
  + lOpenCL via local memory pagination

− Improve data-parallelism to take better advantage of the current architecture
  + lImplementation of more complex algorithms: watershed, arrow, labelling, minima, ...

References

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