SALTAR Project Overview

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Deliverables

- SALTAR
  - DSL
  - Compiler
  - Autotuner
- New approximation algorithms
- Benchmark Suite

Prior Work

- Pachoir compiler [17]
- PLUTO [7], [6]
- Fourst compiler (FFT based) [4]
- Halide (C++ DSL) [16]
- Devito (FD focus, useful resource) [14]

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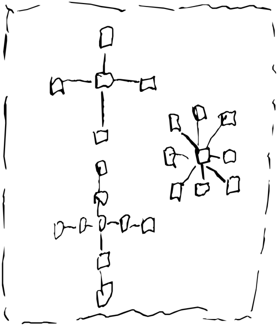
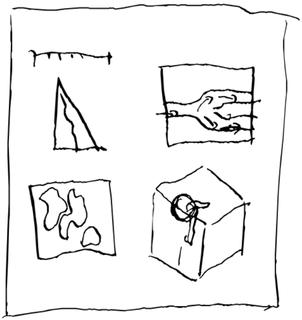
Stencil System

- 1 or more stencil operation
- Each stencil is fully programmable
  - Like a shader, SPMD
  - Limited write access
- Can vary
  - Spatially
  - Temporally
  - By domain composition



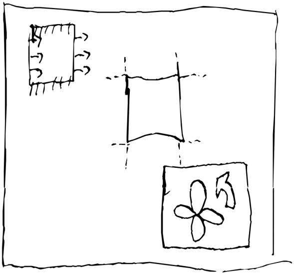
Domain

- Node graph / connectivity
- May be geometry driven
- Should be programmable (?)
  - Condensation problems
- Lots of axis aligned boxes in practice
- Might include “coloring” to map different stencils
- Where do want to sample?
- Durating of runtime
  - How often do we sample?



Boundary Conditions

- Fully programmable
  - Highly dependent on domain and stencil system
- May require sampling
  - Outflow boundary conditions
  - Coupling to other simulations



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FFT

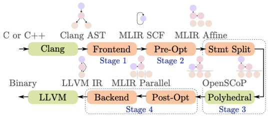
- FFT algorithms [3] [1] [1]

Guassian Approximation

- Guassian Approximation [2]

Polyhedral Compilers

- PLUTO [7], [6]
  - C source to source compiler
  - Access optimized with tiling
- LLVM Polygeist [15]
  - C++ / C interface to MLIR [13]
  - MLIR polyhedral optimization passes
- LLVM Polly [10]
  - Polyhedral optimization of LLVM IR



Polygeist workflow

Misc Techniques

- Branch Removal
  - If statements may have arithmetic based alternative
- Vectorizing
- Data layout / Access patterns (AoS ¡-¿ SoA)

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- Profiling?
- Plan Composition
- Algorithm Tradeoffs
- Other hyper parameters?

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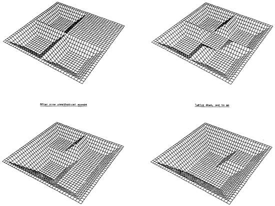
Related Projects

- FFTW [8]
  - Fast fourier transform compiler
  - A dependency(?) for SALTAR
  - Similiar architectural concerns
- Taichi [12]
  - JIT compiler parallel numerical code
  - Optimizes computation over sparse data
  - DSL is based on python.
- Eigen [11]
  - Runtime vs compile time configuration
- FEnics [5]
  - Compiler framework for FEA

Related Algorithms

- HashLife [9]
  - Memoized Algorithm for cellular automata
  - Sensitive to entropy
- Quicklife (Open Source with Golly)
  - Tree based evaluation
  - No hashing



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