Stanford Streaming Supercomputer (SSS) Progress Review

Ian Buck
Computer Systems Laboratory
Stanford University

December 11, 2001
Agenda

• Review Goals
• Progress Status
  – Language
  – Applications
  – Metacompilation
  – Strawman Arch.
Project Goals for Fall Quarter AY2001-2002

• Map two applications to the stream model
  – Fluid flow (TFLO), and molecular dynamics candidates

• Define a high-level stream programming language
  – Generalize stream access without destroying locality

• Draft strawman SSS architecture and identify key issues
Brook Progress

• Full Spec
  – Two drafts written, third on the way

• Quikspec is now available
  http://graphics.stanford.edu/streamlang/quikspec_v0.1.pdf

• Sample perl metacompiler: BPL
  – Used to compile example code only
  – Very helpful for verification

• Basic runtime library: BRT
  – Not parallel, single threaded execution
  – Target for metacompiler
Molecular Dynamics

- Basic kernel code compiling and running.
- Grid optimized version is spec’d out.
- Helpful in defining stream operators

```c
MolclLoad("posdata.txt", pos);
FieldLoad("velocdata.txt", veloc);
FieldLoad("forcedata.txt",force);
MolclPrint(pos, "Position");
FieldPrint(veloc, "Velocity");
/* zero forces */
ZeroField(force);
printf("\nDoing Interaction...\n\n");
/* Computation of forces */
/* Compute long ranged forces at time t */
MolclInteractions (pos, pos, force, force);
FieldPrint(force, "Force 1");
/* Compute bond forces at time t */
MolclSpringForces (pos, force);
/* Computation of forces is now complete. */
/* update velocity from t-dt/2 to t+dt/2 */
/* v(t+dt/2) = v(t-dt/2) + dt * Force(t) */
VelocUpdate (force, veloc);
/* Update position using */
/* pos(t+dt) = pos(t) + dt * veloc(t+dt/2) */
PostnUpdate (veloc, pos);
MolclPrint(pos, "Pos");
FieldPrint(force, "Force 2");
```

---

Dec 11, 2001
TFLO code

- Euler Flux calculations have been coded up in Brook
- Complete single block code being ported.

SSS: 6
MetaCompilation

- Metacompilation work started.
- Simple example are compiling.
- Demo
Strawman

• Mattan, Ben S.
Brook Next Steps

- Iterate on the Quikspec.
- Finish draft 3 of full spec
- Update BPL metcompiler and BRT library to spec
- Handoff BRT to SVM team (F. and M.)
- Banded matrix solver example
Winter Qtr. Goals

- Brook (previous slide) (Ian)
- Arch. (Mattan, Ben S., Tim)
  - Identify analysis necessary
  - Running simulation of example program.
  - Experiment with numbers in Strawman.
  - Cost Model
  - Define global mechanisms.
  - Evaluate conditional alternatives.
- Applications
  - Working Aps with real data
  - Micro-benchmarks/Stress Tests (Ian)
    - FFT
    - Sorting
    - PCA aps (corner turns)
    - Ax=b
  - Complete Molcl gridding
  - TFLO block code
  - Implicit fluid flow
  - RayTracing (Tim P.)
  - UMT2000 Purple Benchmark (Ian)
- Metacompiler
  - Match Brook spec with compiler capabilities. (Ben C.)
- Identify analysis in compiling for SSS.
  - How to compile well to SSS arch (Mattan)
- SVM Spec (Francois)
- SVM Targets
  - Workstation (Francois)
  - MPI library
  - StreamC/KernelC
Winter Qtr. Meetings

- Start in Tuesday, Jan 15th 11:00-12:00

- Numerical Systems (Ron)
- Define SVM (Francois)
- Languages and Hardware (Alan)
- Brook to Hardware discussion
- Parallel Languages (Pat)
- Analysis and Optimization (Mattan)
- Goal Reviews
- Goal Reviews
Plan for AY2001-2002

From Oct 9th:

- **App 1**
  - Fall: Map
  - Winter: Code
  - Spring: Eval

- **App 2**
  - Fall: Map
  - Winter: Code
  - Spring: Eval

- **SPL**
  - Fall: Design
  - Winter: Prototype
  - Spring: Imp (Frost)
    - (nVidea)

- **Arch**
  - Fall: Strawman
  - Winter: Experiments
  - Spring: Eval

Demonstrated performance potential of two applications on SSS