SvPablo: A Graphical Source Code Browser for Performance Tuning and Visualization

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Project Participants

- **Principal Investigator**
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- **Staff and Post-doctoral Associates**
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Outline

- Background
- SvPablo overview
- SvPablo model
- Interactive instrumentation of programs
- Example
- Conclusions and software availability

Background

- Motivations
  - emerging high-level languages (HPF and HPC++)
  - aggressive code transformations for parallelism
  - large semantic gap between user and code
- Goals
  - relate dynamic performance data to source
  - hide semantic gap
  - generate instrumented executable/simulated code
  - support performance scalability predictions
SvPablo Overview

SvPablo Provides:

- performance data capture,
- analysis, and
- presentation

for applications executing on a variety of sequential and parallel platforms.

SvPablo Overview

A graphical user interface tool for:

- source code instrumentation
- browsing runtime performance data

Two major components:

- performance instrumentation libraries
- performance analysis and presentation
SvPablo Overview

- **Instrumentation**
  - automatic
    - HPF (from PGI)
  - interactive
    - ANSI C
    - Fortran 77
    - Fortran 90

- **Data capture**
  - dynamic software statistics (no traces)
  - SGI R10000 counter values

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SvPablo Overview

- **source code instrumentation**
  - HPF: PGI runtime system invokes instrumentation
    - each procedure call
    - each HPF source line
  - C and Fortran programs: interactively instrumented
    - outer loops
    - function calls

- instrumentation maintains statistical summary
- summaries correlated across processors
- correlated summary input to browser
SvPablo Overview

- **Architectures:**
  - any system with the PGI HPF compiler
  - any system with F77 or F90
  - C applications supported on
    - single processor Unix workstations
    - network of Unix workstations using MPI
    - Intel Paragon
    - Meiko CS2

- **Graphical User Interface supports:**
  - Sun (Solaris)
  - SGI (IRIX)

Procedure Statistics Metrics

- **count**
- **exclusive duration**
- **inclusive duration**
- **send message duration** (HPF only)
- **receive message duration** (HPF only)
Line Statistics Metrics

- count
- duration
- exclusive duration
- message send and message receive (HPF)
  - duration
  - count
  - size
- R10K event counters

Metrics Statistics

- mean
- standard deviation
- minimum value
- task number corresponding to minimum value
- maximum value
- task number corresponding to maximum value
SvPablo Model

PROJECT

Source files  Performance contexts

...  ...

Performance data  Performance data

SvPablo Main Window
Project Menu

New Project Dialog Box
Performance Context

C/F77/F90 Data Flow

- Create or edit project
- Instrument C or Fortran files
- Visualize performance file
- Instrumented source code
- Compiler
- Instrumented object code
- Linker
- Instrumented executable
- Parallel Architecture
- SvPablo
- SvPabloCombine
- Per-process performance files
- Performance file
Interactive Instrumentation

Instrumentable Constructs (function calls and outer loops)

Line Instrumentation
Generating Instrumented Executable Program

- mpicc -c file1.Context1.inst.c
- mpicc -c file2.Context1.inst.c
- mpicc -c Context1/InstrumentationInit.c
- mpicc -o instFile InstrumentationInit.o

file1.Context1.inst.o
file2.Context1.inst.o
svPabloDcl.a
(similar for Fortran 77 and Fortran 90)

Visualizing Routines Performance

Metrics:
- count & exclusive duration
Function Visualization

Source Code Visualization

Selected function

Metrics
Multiple Events Metric Box

Performance Metric Selection Dialog
Performance Statistics

Application Tuning Example

- 3D numerical model to simulate cloud and density current dynamics
- translated from CM-Fortran to HPF
- approximately 9000 lines
- running on the SGI Origin 2000
Original MSTFLOW

Modified MSTFLOW
SvPablo Software Availability

■ Features:
  – C, Fortran, and HPF performance analysis
  – SUN Solaris and SGI support
  – SGI hardware counters (R10000)

■ WWW URL:
  – http://www-pablo.cs.uiuc.edu/

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