

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

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## Project Participants

- Principal Investigator
  - Dan Reed
- Staff and Post-doctoral Associates
  - Ruth Aydt
  - Luiz DeRose
  - Roger Noe
  - Mario Pantano
  - Jonathan Reid
  - J.C. Wang
  - Ying Zhang

## 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

## 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)

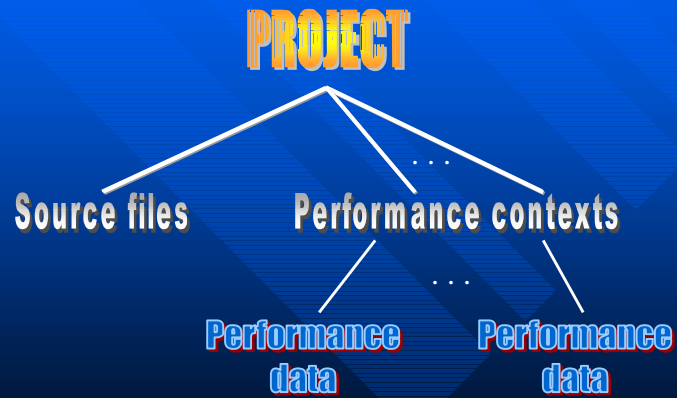
## Line Statistics Metrics

- 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



# SvPablo Main Window



# Project Menu

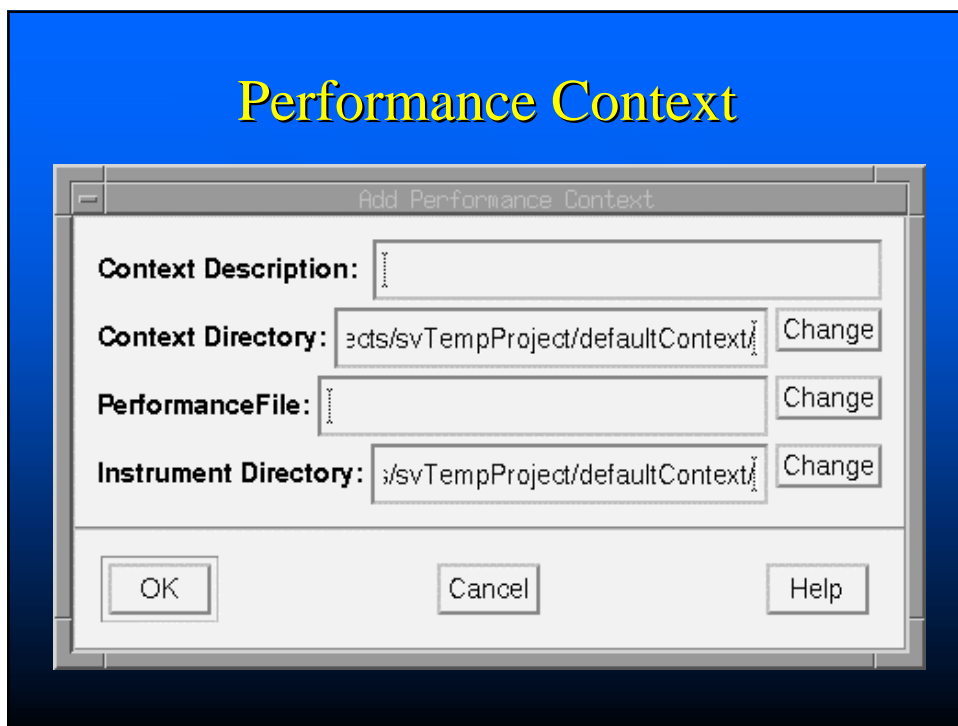


# New Project Dialog Box

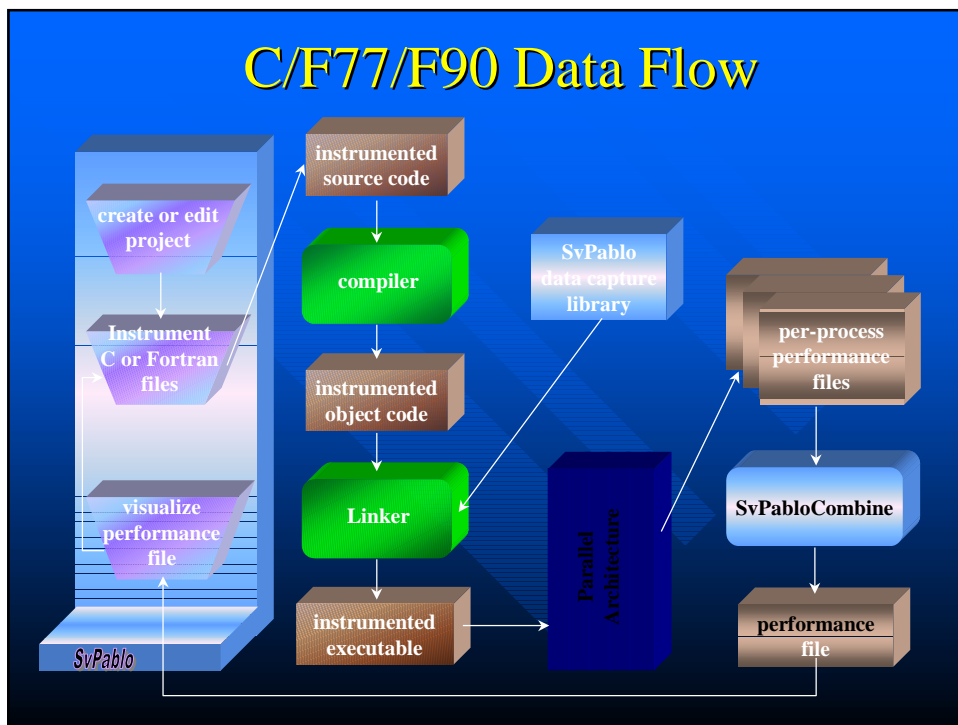




## Performance Context



## C/F77/F90 Data Flow





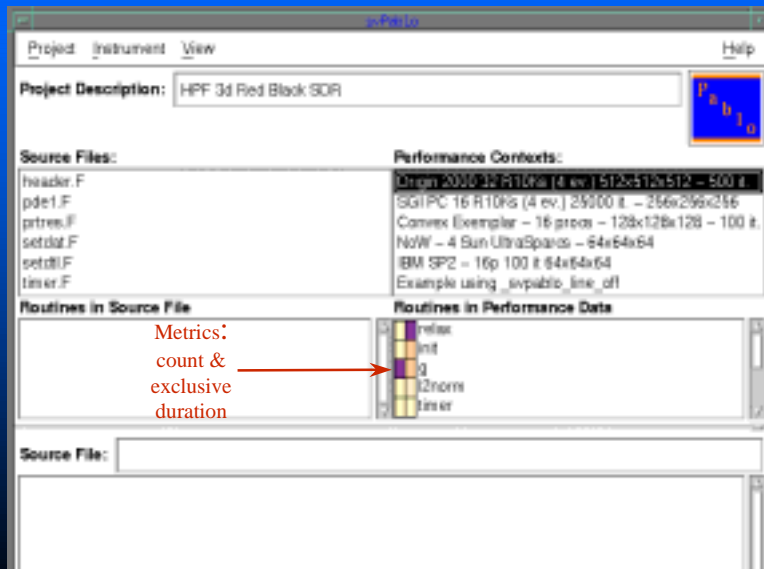


# Generating Instrumented Executable Program

- 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



# Metric Values

**Project Description:** HPP 3d Fed Back SCR

**Source Files:**

- header.F
- pdel.F
- prho.F
- vrho.F
- vrho2.F
- vrho3.F

**Performance Contexts:**

- OS: PC: 16 FLOPS (3 rev) 25600 k - 256036256
- Compl Example - 18 proc - 128(128)128 - 180 k
- HW - 4 Sun UltraSPARC - 64kx4kx4
- BM CPU - 10p 102 x 544kx64
- Example using \_copyable\_line\_of

**Routines in Source File:**

- init
- end
- 0 calls
- 0 lines

**Routines in Performance Data:**

- Cumulative time for 0 calls: 8404.78742320
- Number of calls for 0: 1468(19.40280080)
- Cumulative time for init: 2418.9367045

**Source File:**

- Column 1: Number of calls for 0: 1468(19.40280080)
- Column 2: Cumulative time for 0: 8404.78742320

# Procedure Statistics

**Task:** 0 - 31

**File Name:** pdel.F **Routine Name:** rdel()

**Line Number:** 128

**Source Code Fragment:**

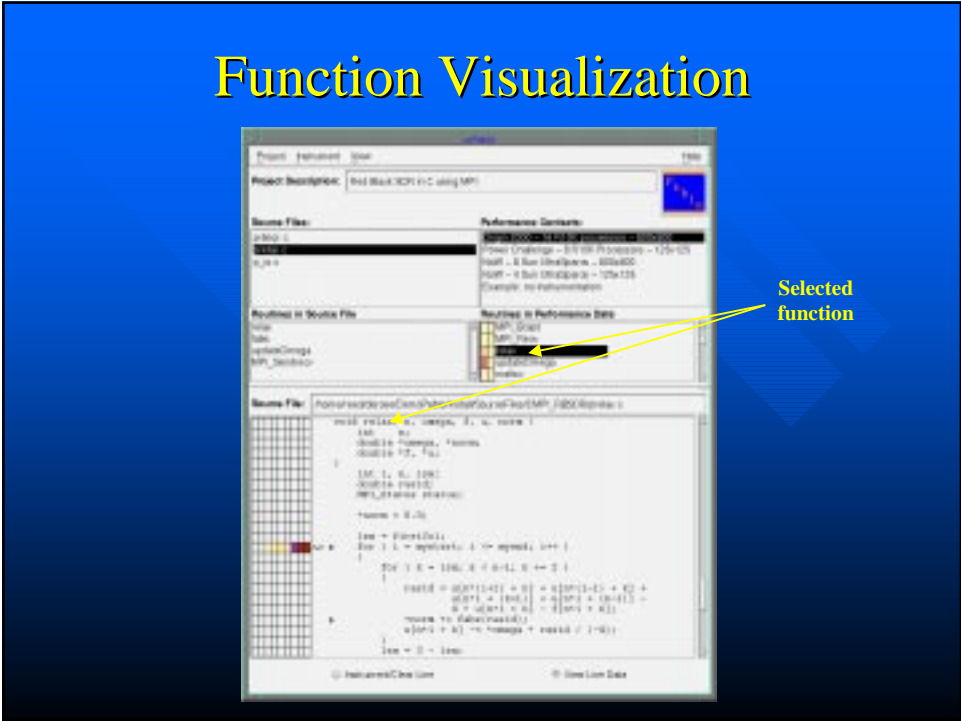
```

SUBROUTINE RDEL(UP, BROW, NROW, NCOL, ITR)
C
C 3D FED BACK RELAXATION STANDARD IMPLEMENTATION  C
    
```

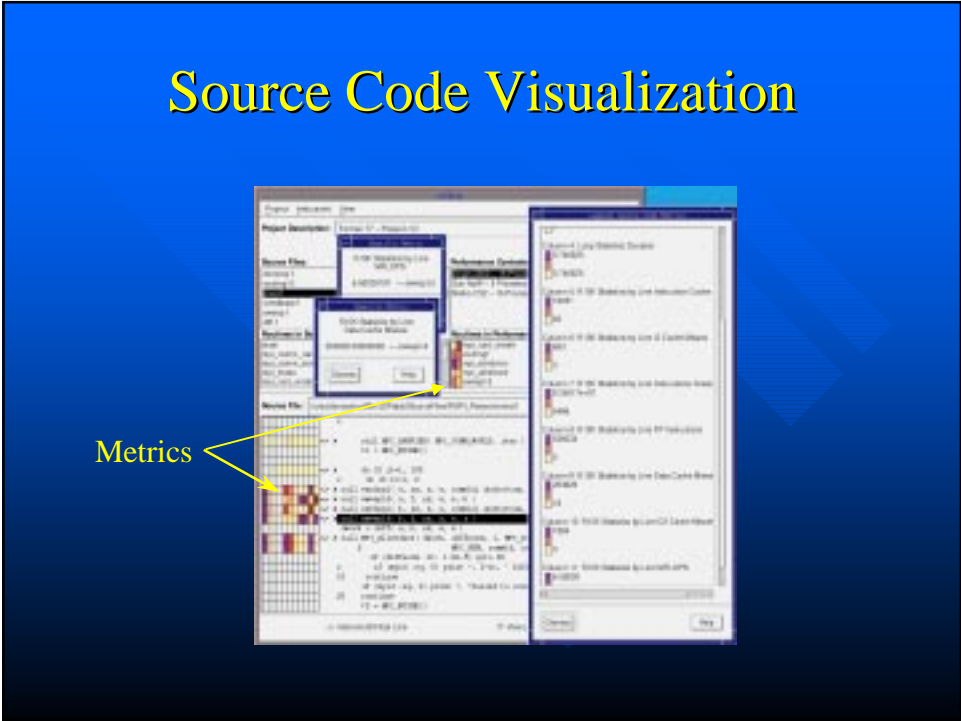
**Overall Procedure Performance Data**

Field Name	Min	Value	Max	Task	Value	Min	Task	Std Dev
Count	1.000000	1.000000	1.000000	0	1.000000	0	0	0.000000
Exclusive Duration	8404.787422	8763.465408	9793.465408	19	0.487011	31	1793.432799	
Inclusive Duration	8404.787422	8763.465408	9793.465408	19	0.487011	31	1793.432799	
Send Msg Duration	668.789047	817.808008	917.808008	1	0.000000	31	186.162936	
Receive Msg Duration	451.476885	876.808008	976.808008	30	0.000000	31	182.236331	

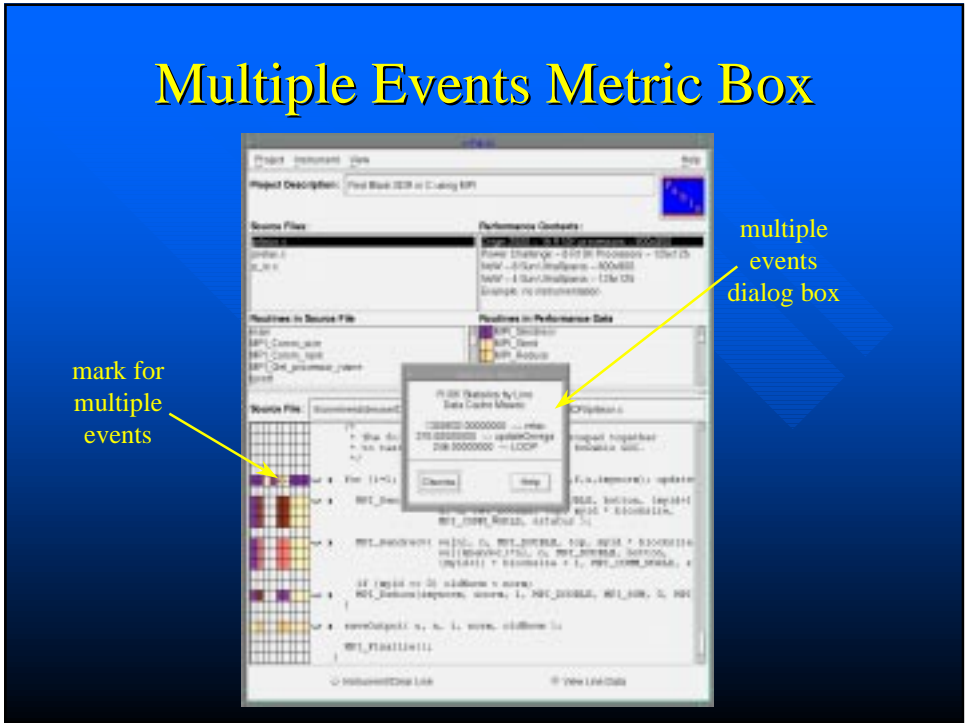
# Function Visualization



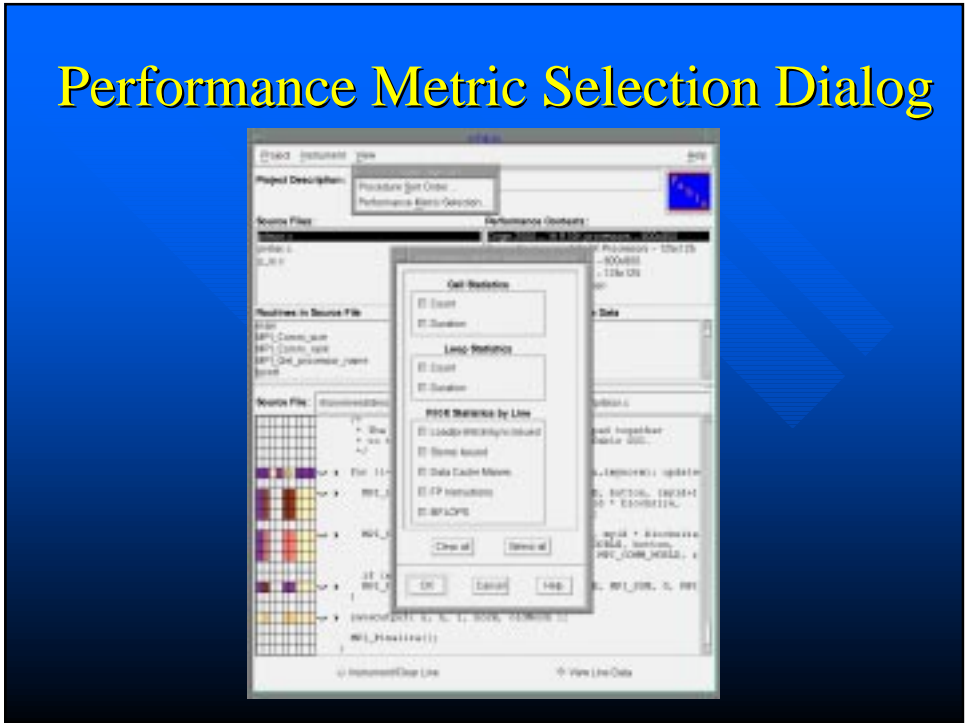
# Source Code Visualization



# Multiple Events Metric Box



# Performance Metric Selection Dialog



## Performance Statistics

Metric details

Metric Name	Mean	Value	Min	Max	Unit	Type
Count	10,000,000	10,000,000	0	10,000,000		C
Summed	143,700,000	143,700,000	0	143,700,000		C
Exclusive Summed	143,700,000	143,700,000	0	143,700,000		C
Count Array Summed	1,000,000	1,000,000	0	1,000,000		C

Task Number	Count	Summed	Exclusive Summed	Count Array Summed	Unit
0	10,000,000	143,700,000	143,700,000	1,000,000	C
1	10,000,000	143,700,000	143,700,000	1,000,000	C
2	10,000,000	143,700,000	143,700,000	1,000,000	C
3	10,000,000	143,700,000	143,700,000	1,000,000	C

## 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





## 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/>
- Contact email address:
  - [pablo-feedback@guitar.cs.uiuc.edu](mailto:pablo-feedback@guitar.cs.uiuc.edu)