

Performance Analysis with Vampir







Outline

Part I: Welcome to the Vampir Tool Suite

- Event Trace Visualization
- The Vampir Displays
- Vampir & VampirServer

Part II: Vampir Hands-On

Visualizing and Analyzing NPB-MZ-MPI / BT

Part III: Vampir Analysis Exercise

Analysing Four Application Traces



Event Trace Visualization with Vampir

 Visualization of dynamic runtime behaviour at any level of detail along with statistics and performance metrics
 Alternative and supplement to automatic analysis

Typical questions that Vampir helps to answer

- What happens in my application execution during a given time in a given process or thread?
- How do the communication patterns of my application execute on a real system?
- Are there any imbalances in computation, I/O or memory usage and how do they affect the parallel execution of my application?

Timeline charts

 Application activities and communication along a time axis



Summary charts

 Quantitative results for the currently selected time interval



Event Trace Visualization with Vampir

The value of seeing how an application executes on the machine

- Application code computing coulomb forces
- The workload was distributed evenly across available processes
- The user expected perfect parallelized code
- However the underlying algorithm worked differently than expected

Visualization of the application execution instantly shows a problem in the parallelization approach



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Main Performance Charts of Vampir

Timeline Charts



- Master Timeline
- Process Timeline
- Summary Timeline
- Performance Radar
- Counter Data Timeline
- I/O Timeline

- all threads' activities
- single thread's activities
- all threads' function call statistics
- all threads' performance metrics
- single threads' performance metrics
- all threads' I/O activities

Summary Charts



- Process Summary Communication Matrix View
 - Call Tree

Visualization Modes (1) Directly on front end or local machine

% vampir



Visualization Modes (2)

On local machine with remote VampirServer





Hands-on: Visualizing and analyzing NPB-MZ-MPI / BT



Help! Where is my trace file?

<pre>% ls /p/scratch/cjzam11/\$USER/NPB3.3-MZ-MPI/bin.scorep/\ > scorep bt-mz C 8x4 trace</pre>							
profile.cubex	scorep.cfg	traces/	traces.def	traces.otf2			
°. le /r/here/t		-hound / coor					
<pre>% IS /p/nome/j profile.cubex</pre>	scorep.cfg	traces/	traces.def	x4_trace traces.otf2			

 If you followed the Score-P hands-on up to the trace experiment

 If you did not follow to that point, take a prepared trace

Start Vampir

```
% module load Vampir/9.6.1
```

```
% vampir <tracefile>
```

```
% vampir /p/scratch/cjzam11/$USER/NPB3.3-MZ-MPI/bin.scorep/\
> scorep_bt-mz_C_8x4_trace/traces.otf2
```

- Load correct module to add local tool installations to \$PATH (required for each shell session)
- Start Vampir on the current login-node (requires ssh X-forwarding)

	Vampir - [Trace View - /home/dolescha/tracefiles/feature-	races/wrf-p64-io-mem-	-rusa	age/wrf.1h.otf]	نها ها
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Process 3	MPI_Wait MPI Wait	solve_em_		VT API	
Process 4	module_em_mp_rk_step_prep	solve_em_		WRF	
Process 5	MPI_Wait	solve_em_			
Process 6	module_em_mp_rk_step_prep_	solve_em_			
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Process 13	MPEWait	solve_em_		Function Name	MPI_wait
Process 14	module_em_mp_rk_step_prep_	solve_em_		Interval Begin	26.872264 s
Process 15	module_em_mp_rk_step_prep_	solve_em_		Interval End	26.885236 s
Process 16	module_em_mp_rk_step_prep_	/solve_em_		Duration	0.012972 s
Process 17	module_em_mp_rk_step_prep_	solve_em_		Source Line	
Process 18	MPI_Wait Wait Wait	solve_em_		Source Line	
Process 19	module_em_mp_rk_step_prep_	solve_em_			
Process 20	module_em_mp_rk_step_prep	solve_em_			
Process 21	MPI_Wait MPI_Wait	solve_em_			
Process 22	MPI_Wait	solve_em_			
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Process 6 MPI_Irecv	MPI_Isend		9.35 µs RK_STEP_PREP
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Process 9 MPI_Wait			Context View
Process 10 MPI_Irecv	MP1_isend		🗙 🚎 Master Tim
Process 11 MPI_Wait		Property	Value
Process 12 COUPLE_MOMENTOM		Display	Master Timeline
Process 13 SOLVE_EM		Туре	Message
Process 15 SOLVE EM		Message Type	Point to point
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		Destination	Process 2
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		Arrival Time	34.149379 s
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		Size	199.335938 KiB
		Data Rate	892.749376 MiB/s

Visualization of the NPB-MZ-MPI / BT trace



Visualization of the NPB-MZ-MPI / BT trace Master Timeline





Detailed information about functions, communication and synchronization events for collection of processes.

Visualization of the NPB-MZ-MPI / BT trace Process Timeline





Detailed information about different levels of function calls in a stacked bar chart for an individual process.

Visualization of the NPB-MZ-MPI / BT trace Typical program phases



Visualization of the NPB-MZ-MPI / BT trace Counter Data Timeline





Visualization of the NPB-MZ-MPI / BT trace Performance Radar





Visualization of the NPB-MZ-MPI / BT trace Zoom in: Inititialisation Phase



Context View: Detailed information about function "initialize_".

Visualization of the NPB-MZ-MPI / BT trace Find Function



Visualization of the NPB-MZ-MPI / BT trace Computation Phase



Visualization of the NPB-MZ-MPI / BT trace Zoom in: Computation Phase



Visualization of the NPB-MZ-MPI / BT trace Zoom in: Finalisation Phase



Visualization of the NPB-MZ-MPI / BT trace Process Summary





Function Summary: Overview of the accumulated information across all functions and for a collection of processes.

Process Summary: Overview of the accumulated information across all functions and for every process independently.

Visualization of the NPB-MZ-MPI / BT trace Process Summary





Find groups of similar processes and threads by using summarized function information.



Summary and Conclusion



Summary

- Vampir & VampirServer
 - Interactive trace visualization and analysis
 - Intuitive browsing and zooming
 - Scalable to large trace data sizes (20 TiByte)
 - Scalable to high parallelism (200,000 processes)
- Vampir for Linux, Windows, and Mac OS X



http://www.vampir.eu

vampirsupport@zih.tu-dresden.de