Ferramentas de Avaliação de Desempenho

Roteiro

1. Scalasca, Score-p, Cube

2. hpctoolkit

Scalasca

https://www.scalasca.org

Performance Analysis
Tuning
Optimized Application
Measurement
scalasca

Scalasca

Exemplo: NAS Parallel Benchmarks (NPB)

```
scalasca/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_scalasca
       README
```

Scalasca

Exemplo: NAS Parallel Benchmarks (NPB)

```
scalasca/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_scalasca
       README
```

Scalasca

Preparando o ambiente

```
$ cat env_scalasca

module load openmpi/gnu/2.0.4.2
module load scalasca/2.4_openmpi_gnu
module load papi/5.5.1.0
module load papi-devel/5.5.1.0
```

Scalasca

Preparando o ambiente

```
$ source env_scalasca
scalasca 2.4 for GNU OpenMPI loaded
Compiled with openMPI 2.0.4.2 and GNU compilers Red Hat 4.8.5-36

$ scalasca
Scalasca 2.4
Toolset for scalable performance analysis of large-scale parallel applications
usage: scalasca [-v][-n] action
    1. prepare application objects and executable for measurement:
       scalasca -instrument <compile-or-link-command> # skin (using scorep)
    2. run application under control of measurement system:
       scalasca -analyze <application-launch-command> # scan
    3. interactively explore measurement analysis report:
       scalasca -examine <experiment-archive|report>  # square

Options:
   -c, --show-config     show configuration summary and exit
   -h, --help            show this help and exit
   -n, --dry-run         show actions without taking them
       --quickref        show quick reference guide and exit
       --remap-specfile  show path to remapper specification file and exit
   -v, --verbose         enable verbose commentary
   -V, --version         show version information and exit
```

Scalasca

scalasca -instrument (skin/scorep)

```
scalasca/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_scalasca
       README
```

Scalasca

scalasca -instrument (skin/scorep)

```
scalasca/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
          bin/
          BT-MZ/
          common/
          config/
          LU-MZ/
          SP-MZ/
          sys/
          Makefile
          README
          README.install
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_scalasca
       README
```

Scalasca

scalasca -instrument (skin/scorep)

```
scalasca/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
          bin/
          BT-MZ/
          common/
          config/
          LU-MZ/
          SP-MZ/
          sys/
          Makefile
          README
          README.install
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_scalasca
       README
```

Scalasca

`scalasca -instrument (skin/scorep)`

```
config/
   NAS.samples
   make.def -> make_scalasca.def
   make.def.template
   make_scalasca.def
   suite.def
   suite.def.template
```

Scalasca

scalasca -instrument (skin/scorep)

```
config/
   NAS.samples
   make.def -> make_scalasca.def
   make.def.template
   make_scalasca.def
   suite.def
   suite.def.template
```

Scalasca

scalasca -instrument (skin/scorep)

```
$ cat make_scalasca.def

#---------------------------------------------------------------------------
# This is the fortran compiler used for fortran programs
#---------------------------------------------------------------------------
#F77 = mpif77
F77 = scalasca -instrument mpif77
#F77 = scorep mpif77


#---------------------------------------------------------------------------
# This is the C compiler used for C programs
#---------------------------------------------------------------------------
#CC = mpicc
CC = scalasca -instrument mpicc
#CC = scorep mpicc
```

Scalasca

NPB: benchmark, classe e número de processos MPI

```
config/
   NAS.samples
   make.def -> make_scalasca.def
   make.def.template
   make_scalasca.def
   suite.def
   suite.def.template
```

Scalasca

NPB: benchmark, classe e número de processos MPI

```
config/
   NAS.samples
   make.def -> make_scalasca.def
   make.def.template
   make_scalasca.def
   suite.def
   suite.def.template
```

Estudo de caso

NPB: benchmark, classe e número de processos MPI

```
$ cat suite.def

# config/suite.def
# This file is used to build several benchmarks with a single command.
# Typing "make suite" in the main directory will build all the benchmarks
# specified in this file.
# Each line of this file contains a benchmark name, class, and number
# of nodes. The name is one of "sp-mz", "bt-mz", and "lu-mz".
# The class is one of "S", "W", and "A" through "F".
# No blank lines.
# The following example builds serial sample sizes of all benchmarks.
#sp-mz S 1
#lu-mz S 1
#bt-mz S 2
bt-mz   S       1
bt-mz   S       2
bt-mz   S       4
bt-mz   W       1
bt-mz   W       2
bt-mz   W       4
bt-mz   W       8
bt-mz   W       16
```

Estudo de caso

NPB: compilação

```
$ cd ..
$ make suite %compila o NPB
$ cd bin
```

Estudo de caso

NPB: compilação

```
$ ls -A1
bt-mz.S.1
bt-mz.S.2
bt-mz.S.4
bt-mz.W.1
bt-mz.W.2
bt-mz.W.4
BULL_srun_scan_prof.sh
BULL_srun_scan_trace.sh
BULL_srun_scan_trace_filt.sh
```

Scalasca

scalasca -analyze: coleta de dados da execução

```
$ ls -A1
bt-mz.S.1
bt-mz.S.2
bt-mz.S.4
bt-mz.W.1
bt-mz.W.2
bt-mz.W.4
BULL_srun_scan_prof.sh
BULL_srun_scan_trace.sh
BULL_srun_scan_trace_filt.sh
```

Scalasca

`BULL_srun_scalasca.sh`

Estudo de caso

NPB: submetendo job

```
$ sbatch BULL_srun_scan_prof.sh bt-mz S
Submitted batch job 437607
$ squeue -u $USER
JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
437607 treinamen NPB_BT-M professo  R       0:02      1 sdumont3000
```

Estudo de caso

NPB: perfil de desempenho

```
$ ls -A1
bt-mz.S.1
bt-mz.S.2
bt-mz.S.4
bt-mz.W.1
bt-mz.W.2
bt-mz.W.4
BULL_srun_scan_prof.sh
BULL_srun_scan_trace.sh
BULL_srun_scan_trace_filt.sh
scorep_bt-mz_S_sum_MPI-1_OMP-1_JOBID-437607/
```

Estudo de caso

NPB: perfil de desempenho

```
scorep_bt-mz_S_sum_MPI-1_OMP-1_JOBID-437607/
   profile.cubex
   summary.cubex
   scorep.score
   scorep.cfg
   scorep.log
   slurm-437607.out
```

Estudo de caso

NPB: perfil de desempenho

```
scorep_bt-mz_S_sum_MPI-1_OMP-1_JOBID-437607/
   profile.cubex    --> análise básica, a partir de dados coletados durante execução
   summary.cubex    --> análise mais detalhada
   scorep.score     --> relatório formato texto com a análise
   scorep.cfg       --> configuração da coleta de dados
   scorep.log       --> output da aplicação
   slurm-437607.out --> output do SLURM
```

Estudo de caso

NPB: perfil de desempenho

```
scorep_bt-mz_S_sum_MPI-1_OMP-1_JOBID-437607/
   profile.cubex
   summary.cubex
   scorep.score
   scorep.cfg
   scorep.log
   slurm-437607.out
```

Estudo de caso

```
$ cat slurm-437607.out

Cluster configuration:
===
Partition:  treinamento
Number of nodes:   1
Number of MPI processes:  1  ( 1  nodes)
Number of MPI processes per node:  1
Number of threads per MPI process:  1
NPB Benchmark:  bt-mz
Bechmark class problem:  S
scalasca 2.4 for GNU OpenMPI loaded
Compiled with openMPI 2.0.4.2 and GNU compilers Red Hat 4.8.5-36
S=C=A=N: Scalasca 2.4 runtime summarization
S=C=A=N: ./scorep_bt-mz_1x1_sum experiment archive
S=C=A=N: Tue Jan 28 14:17:02 2020: Collect start
/usr/bin/srun --resv-ports -n 1 /scratch/treinamento/professor/MC1-I/tools/scalasca/NPB3.3.1-MZ/NP
[1580231823.240921] [sdumont5000:73441:0]         mxm.c:196  MXM  WARN  The 'ulimit -s' on the sys
[1580231823.242634] [sdumont5000:73441:0]         mxm.c:196  MXM  WARN  The 'ulimit -s' on the sys


 NAS Parallel Benchmarks (NPB3.3-MZ-MPI) - BT-MZ MPI+OpenMP Benchmark

 Number of zones:   2 x   2
 Iterations:  60    dt:   0.010000
 Number of active processes:     1
```

Estudo de caso (cont.)

```
Use the default load factors with threads
Total number of threads:      1  (  1.0 threads/process)

Calculated speedup =      1.00

Time step    1
Time step   20
Time step   40
Time step   60
Verification being performed for class S
accuracy setting for epsilon =  0.1000000000000E-07
Comparison of RMS-norms of residual
          1 0.1047687395830E+04 0.1047687395830E+04 0.1751386499571E-12
          2 0.9419911314792E+02 0.9419911314792E+02 0.1478425555772E-13
          3 0.2124737403068E+03 0.2124737403068E+03 0.9002435039286E-13
          4 0.1422173591794E+03 0.1422173591794E+03 0.3089634277625E-12
          5 0.1135441572375E+04 0.1135441572375E+04 0.3103895484466E-13
Comparison of RMS-norms of solution error
          1 0.1775416062982E+03 0.1775416062982E+03 0.1922618237923E-12
          2 0.1875540250835E+02 0.1875540250835E+02 0.1558955269742E-12
          3 0.3863334844506E+02 0.3863334844506E+02 0.1105356386074E-12
          4 0.2634713890362E+02 0.2634713890362E+02 0.3991337551951E-13
          5 0.1965566269675E+03 0.1965566269675E+03 0.2336704854379E-12
Verification Successful


BT-MZ Benchmark Completed.
Class           =                        S
Size            =             24x   24x  6
Iterations      =                       60
```

Estudo de caso (cont.)

```
 Time in seconds =                     0.35
 Total processes =                        1
 Total threads   =                        1
 Mop/s total     =                  1093.41
 Mop/s/thread    =                  1093.41
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1
 Compile date    =              21 Jan 2020

 Compile options:
    F77          = scalasca -instrument mpif77
    FLINK        = $(F77)
    F_LIB        = (none)
    F_INC        = (none)
    FFLAGS       = -O3 -fopenmp
    FLINKFLAGS   = $(FFLAGS)
    RAND         = (none)


 Please send all errors/feedbacks to:

 NPB Development Team
 npb@nas.nasa.gov


S=C=A=N: Tue Jan 28 14:17:03 2020: Collect done (status=0) 1s
S=C=A=N: ./scorep_bt-mz_1x1_sum complete.
INFO: Post-processing runtime summarization report...
/opt/bullxde/utils/scalasca/openmpi-gnu/scorep/bin/scorep-score -r ./scorep_bt-mz_S_sum_MPI-1_OMP-
```

Estudo de caso (cont.)

```
INFO: Score report written to ./scorep_bt-mz_S_sum_MPI-1_OMP-1_JOBID-437607/scorep.score
```

Estudo de caso

NPB: submetendo job

```
$ sbatch BULL_srun_scan_prof.sh bt-mz W
Submitted batch job 437632
$ squeue -u $USER
JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
% 437632 treinamen NPB_BT-M professo  R       0:02      1 sdumont3000
```

Estudo de caso

NPB: perfil de desempenho

```
scorep_bt-mz_W_sum_MPI-1_OMP-1_JOBID-437632/
   profile.cubex
   summary.cubex
   scorep.score
   scorep.cfg
   scorep.log
   slurm-437632.out
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=1 BULL_srun_scan_prof.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     1

 Use the default load factors with threads
 Total number of threads:      1  (  1.0 threads/process)

 Calculated speedup =      1.00

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =            64x   64x   8
 Iterations      =                      200
 Time in seconds =                    12.59
 Total processes =                        1
 Total threads   =                        1
 Mop/s total     =                  1140.40
 Mop/s/thread    =                  1140.40
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1

S=C=A=N: Tue Jan 28 14:57:17 2020: Collect done (status=0) 14s
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=2 BULL_srun_scan_prof.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     2

 Use the default load factors with threads
 Total number of threads:      2  (  1.0 threads/process)

 Calculated speedup =      1.98

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x   64x  8
 Iterations      =                      200
 Time in seconds =                     6.46
 Total processes =                        2
 Total threads   =                        2
 Mop/s total     =                  2219.05
 Mop/s/thread    =                  1109.53
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1

S=C=A=N: Tue Jan 28 15:01:09 2020: Collect done (status=0) 8s
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=4 BULL_srun_scan_prof.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     4

 Use the default load factors with threads
 Total number of threads:      4  (  1.0 threads/process)

 Calculated speedup =      3.95

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x   64x   8
 Iterations      =                      200
 Time in seconds =                     3.40
 Total processes =                        4
 Total threads   =                        4
 Mop/s total     =                  4206.28
 Mop/s/thread    =                  1051.57
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1

S=C=A=N: Tue Jan 28 15:01:34 2020: Collect done (status=0) 5s
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=8 BULL_srun_scan_prof.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     8

 Use the default load factors with threads
 Total number of threads:      8  (  1.0 threads/process)

 Calculated speedup =      4.87

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x   64x  8
 Iterations      =                      200
 Time in seconds =                     2.82
 Total processes =                        8
 Total threads   =                        8
 Mop/s total     =                  5086.41
 Mop/s/thread    =                   635.80
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1

S=C=A=N: Wed Jan 29 10:51:43 2020: Collect done (status=0) 4s
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=16 BULL_srun_scan_prof.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:    16

 Use the default load factors with threads
 Total number of threads:     16  (  1.0 threads/process)

 Calculated speedup =      4.87

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x   64x  8
 Iterations      =                      200
 Time in seconds =                     2.84
 Total processes =                       16
 Total threads   =                       16
 Mop/s total     =                  5047.62
 Mop/s/thread    =                   315.48
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1

S=C=A=N: Wed Jan 29 10:52:03 2020: Collect done (status=0) 6s
```

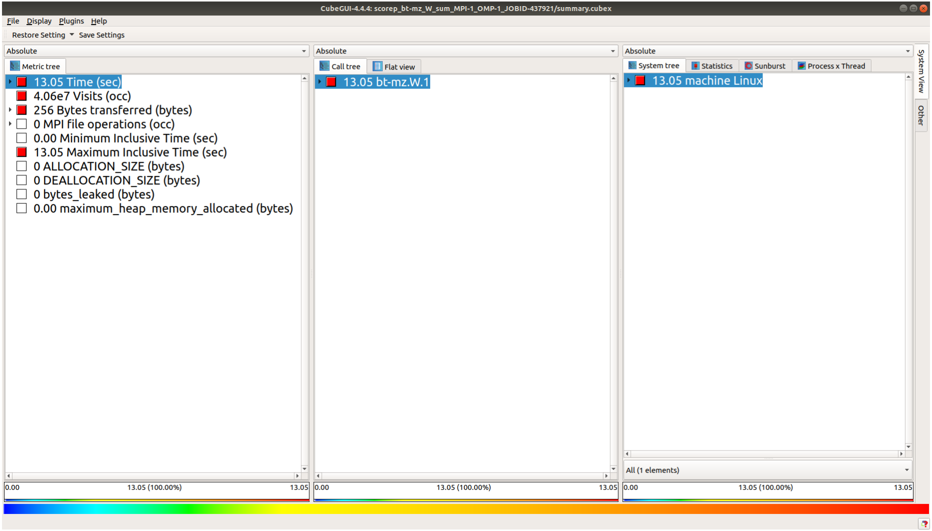
Visualizando no Cube

NPB: estudo de caso

```
$ cd profiling/NUMNODES-1/scorep_bt-mz_W_sum_MPI-1_OMP-1_JOBID-437921
$ cube summary.cubex
```

Visualizando no Cube

`-nodes=1 -ntasks=1`


CubeGUI-4.4.4: scorep_bt-mz_W_sum_MPI-1_OMP-1_JOBID-437921/summary.cubex
File Display Plugins Help
Restore Setting Save Settings
Absolute
Metric tree
Call tree
Flat view
System tree
Statistics
Sunburst
Process x Thread
System View
Other
All (1 elements)

Metric tree:

- 🟥 13.05 Time (sec)
- 🟥 4.06e7 Visits (occ)
- 🟥 256 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- ☐ 0.00 Minimum Inclusive Time (sec)
- 🟥 13.05 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)

Call tree:

- 🟥 13.05 bt-mz.W.1

System tree:

- 🟥 13.05 machine Linux

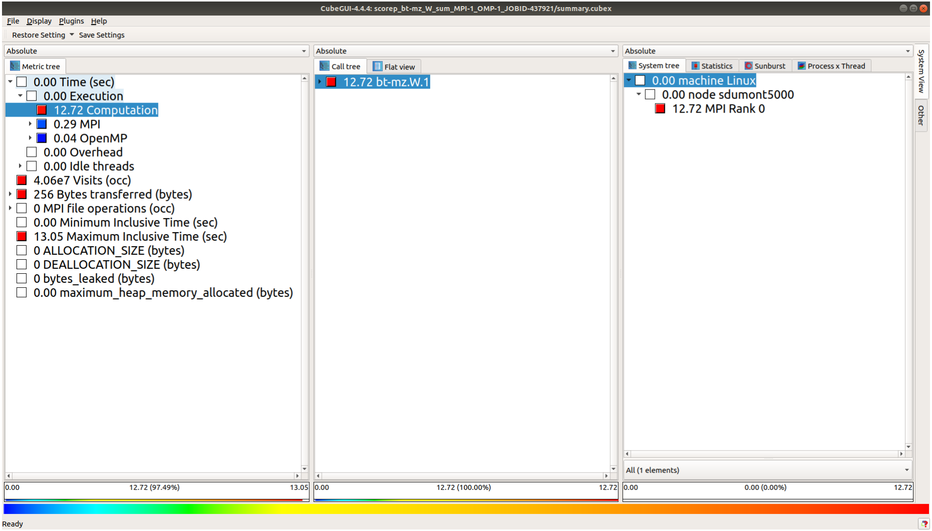
0.00 13.05 (100.00%) 13.05

0.00 13.05 (100.00%) 13.05

0.00 13.05 (100.00%) 13.05

Visualizando no Cube

`-nodes=1 -ntasks=1`



CubeGUI-4.4.4: scorep_bt-mz_W_sum_MPI-1_OMP-1_JOBID-437921/summary.cubex

```
▾ ☐ 0.00 Time (sec)
   ▾ ☐ 0.00 Execution
        ■ 12.72 Computation
      ▸ ■ 0.29 MPI
      ▸ ■ 0.04 OpenMP
     ☐ 0.00 Overhead
   ▸ ☐ 0.00 Idle threads
  ■ 4.06e7 Visits (occ)
▸ ■ 256 Bytes transferred (bytes)
▸ ☐ 0 MPI file operations (occ)
  ☐ 0.00 Minimum Inclusive Time (sec)
  ■ 13.05 Maximum Inclusive Time (sec)
  ☐ 0 ALLOCATION_SIZE (bytes)
  ☐ 0 DEALLOCATION_SIZE (bytes)
  ☐ 0 bytes_leaked (bytes)
  ☐ 0.00 maximum_heap_memory_allocated (bytes)
```

```
0.00              12.72 (97.49%)              13.05
```

```
▸ ■ 12.72 bt-mz.W.1
```

```
0.00              12.72 (100.00%)             12.72
```

```
▾ ☐ 0.00 machine Linux
   ▾ ☐ 0.00 node sdumont5000
        ■ 12.72 MPI Rank 0
```

```
All (1 elements)
0.00              0.00 (0.00%)                12.72
```

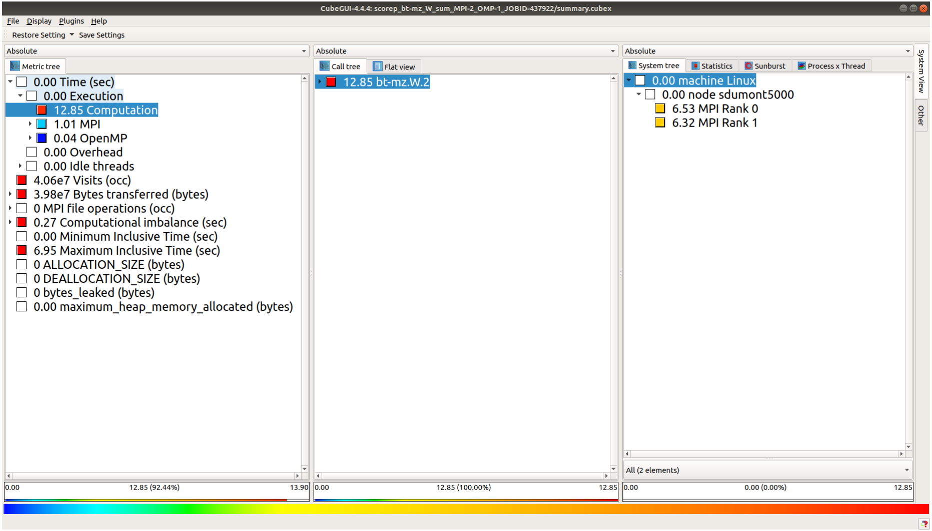
Visualizando no Cube

divisão do tempo de processamento

- Tempo de computação: 12.72s
- Tempo de MPI: 0.29s
- Tempo de OpenMP: 0.04s

Visualizando no Cube

`-nodes=1 -ntasks=2`



```
▾ ☐ 0.00 Time (sec)
  ▾ ☐ 0.00 Execution
      🟥 12.85 Computation
    ▸ 🟦 1.01 MPI
    ▸ 🟦 0.04 OpenMP
    ☐ 0.00 Overhead
  ▸ ☐ 0.00 Idle threads
  🟥 4.06e7 Visits (occ)
▸ 🟥 3.98e7 Bytes transferred (bytes)
▸ ☐ 0 MPI file operations (occ)
▸ 🟥 0.27 Computational imbalance (sec)
  ☐ 0.00 Minimum Inclusive Time (sec)
  🟥 6.95 Maximum Inclusive Time (sec)
  ☐ 0 ALLOCATION_SIZE (bytes)
  ☐ 0 DEALLOCATION_SIZE (bytes)
  ☐ 0 bytes_leaked (bytes)
  ☐ 0.00 maximum_heap_memory_allocated (bytes)
```

```
0.00          12.85 (92.44%)          13.90
```

```
▸ 🟥 12.85 bt-mz.W.2
```

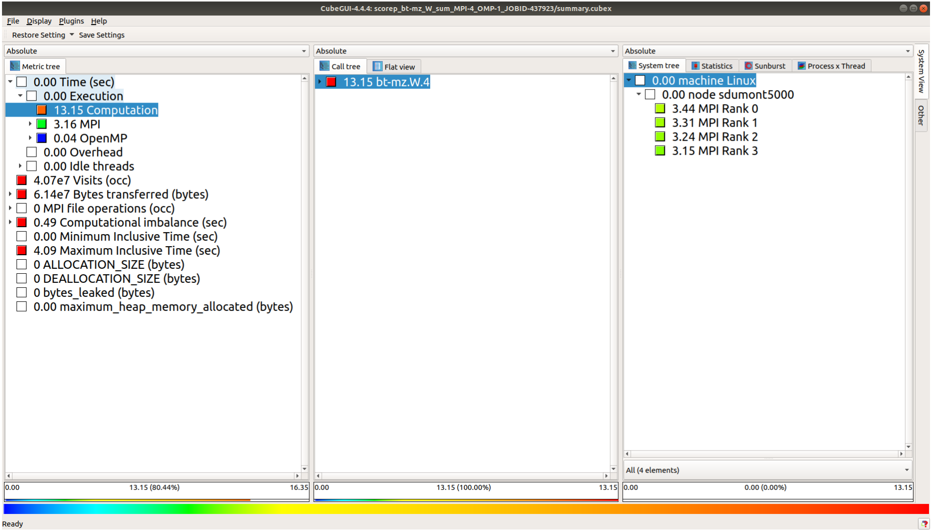
```
0.00          12.85 (100.00%)          12.85
```

```
▾ ☐ 0.00 machine Linux
  ▾ ☐ 0.00 node sdumont5000
      🟨 6.53 MPI Rank 0
      🟨 6.32 MPI Rank 1
```

```
0.00          0.00 (0.00%)          12.85
```

Visualizando no Cube

-nodes=1 -ntasks=4



Metric tree:

- ☐ 0.00 Time (sec)
  - ☐ 0.00 Execution
    - 🟧 13.15 Computation
    - 🟩 3.16 MPI
    - 🟦 0.04 OpenMP
  - ☐ 0.00 Overhead
  - ☐ 0.00 Idle threads
- 🟥 4.07e7 Visits (occ)
- 🟥 6.14e7 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- 🟥 0.49 Computational imbalance (sec)
- ☐ 0.00 Minimum Inclusive Time (sec)
- 🟥 4.09 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)

0.00 13.15 (80.44%) 16.35

Call tree:

- 🟥 13.15 bt-mz.W.4

0.00 13.15 (100.00%) 13.15

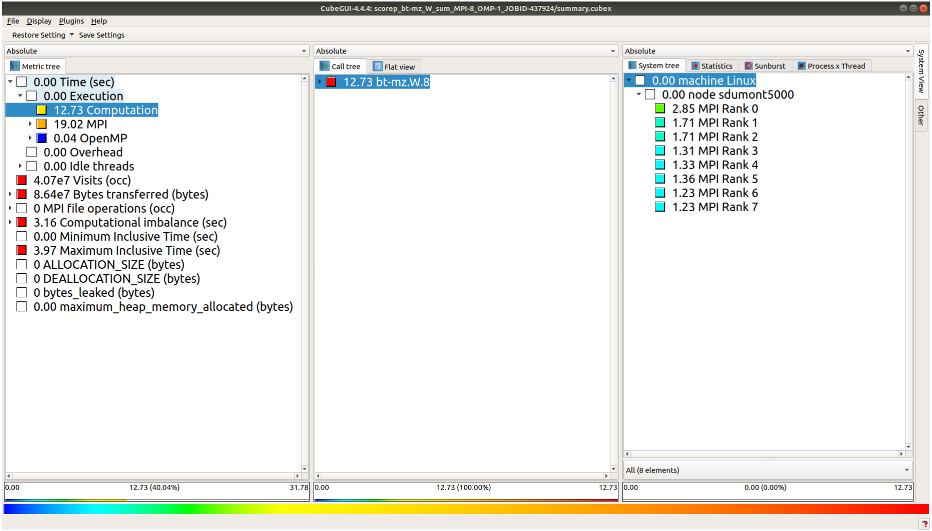
System tree:

- ☐ 0.00 machine Linux
  - ☐ 0.00 node sdumont5000
    - 🟩 3.44 MPI Rank 0
    - 🟩 3.31 MPI Rank 1
    - 🟩 3.24 MPI Rank 2
    - 🟩 3.15 MPI Rank 3

0.00 0.00 (0.00%) 13.15

Visualizando no Cube

`-nodes=1 -ntasks=8`



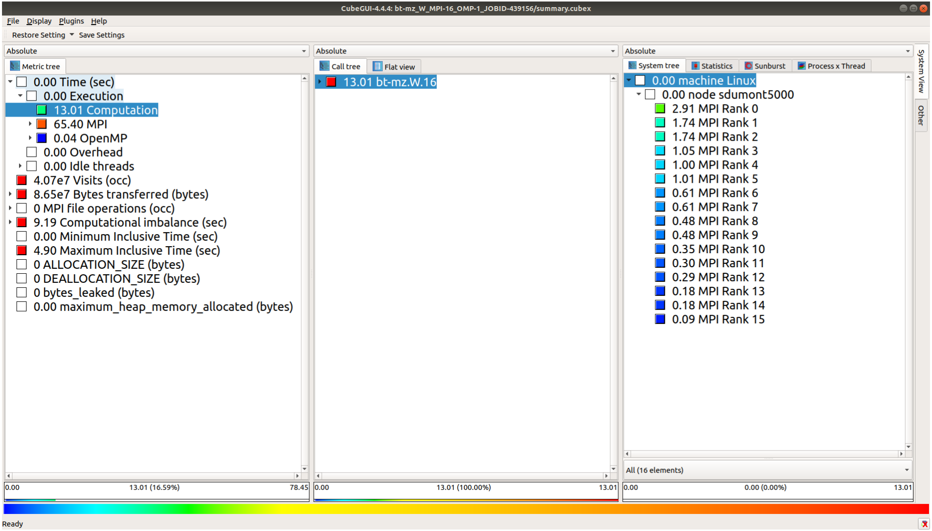
- ☐ 0.00 Time (sec)
  - ☐ 0.00 Execution
    - 🟨 12.73 Computation
    - 🟧 19.02 MPI
    - 🟦 0.04 OpenMP
  - ☐ 0.00 Overhead
  - ☐ 0.00 Idle threads
- 🟥 4.07e7 Visits (occ)
- 🟥 8.64e7 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- 🟥 3.16 Computational imbalance (sec)
- ☐ 0.00 Minimum Inclusive Time (sec)
- 🟥 3.97 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)

- 🟥 12.73 bt-mz.W.8

- ☐ 0.00 machine Linux
  - ☐ 0.00 node sdumont5000
    - 🟩 2.85 MPI Rank 0
    - 🟩 1.71 MPI Rank 1
    - 🟩 1.71 MPI Rank 2
    - 🟦 1.31 MPI Rank 3
    - 🟦 1.33 MPI Rank 4
    - 🟦 1.36 MPI Rank 5
    - 🟦 1.23 MPI Rank 6
    - 🟦 1.23 MPI Rank 7

Visualizando no Cube

-nodes=1 -ntasks=16


CubeGUI-4.4.4: bt-mz_W_MPI-16_OMP-1_JOBID-439156/summary.cubex
File Display Plugins Help
Restore Setting Save Settings
Absolute
Metric tree
Call tree
Flat view
System tree
Statistics
Sunburst
Process x Thread
System View
Other
Ready

Metric tree:

- ☐ 0.00 Time (sec)
  - ☐ 0.00 Execution
    - 🟩 13.01 Computation
    - 🟧 65.40 MPI
    - 🟦 0.04 OpenMP
  - ☐ 0.00 Overhead
  - ☐ 0.00 Idle threads
- 🟥 4.07e7 Visits (occ)
- 🟥 8.65e7 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- 🟥 9.19 Computational imbalance (sec)
- ☐ 0.00 Minimum Inclusive Time (sec)
- 🟥 4.90 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)

0.00 13.01 (16.59%) 78.45

Call tree:

- 🟥 13.01 bt-mz.W.16

0.00 13.01 (100.00%) 13.01

System tree:

- ☐ 0.00 machine Linux
  - ☐ 0.00 node sdumont5000
    - 🟩 2.91 MPI Rank 0
    - 🟩 1.74 MPI Rank 1
    - 🟩 1.74 MPI Rank 2
    - 🟦 1.05 MPI Rank 3
    - 🟦 1.00 MPI Rank 4
    - 🟦 1.01 MPI Rank 5
    - 🟦 0.61 MPI Rank 6
    - 🟦 0.61 MPI Rank 7
    - 🟦 0.48 MPI Rank 8
    - 🟦 0.48 MPI Rank 9
    - 🟦 0.35 MPI Rank 10
    - 🟦 0.30 MPI Rank 11
    - 🟦 0.29 MPI Rank 12
    - 🟦 0.18 MPI Rank 13
    - 🟦 0.18 MPI Rank 14
    - 🟦 0.09 MPI Rank 15

All (16 elements)

0.00 0.00 (0.00%) 13.01

BT-MZ *benchmark*: divisão de domínio

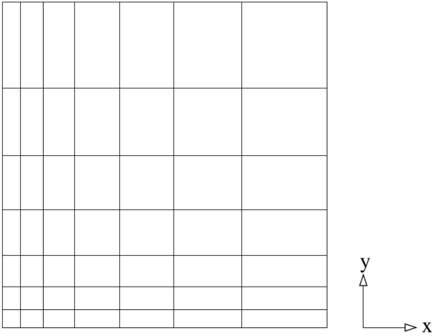


Figure 3: Example of uneven mesh tiling (horizontal cut through mesh system) for the BT-MZ benchmark.

Scalasca

Definição

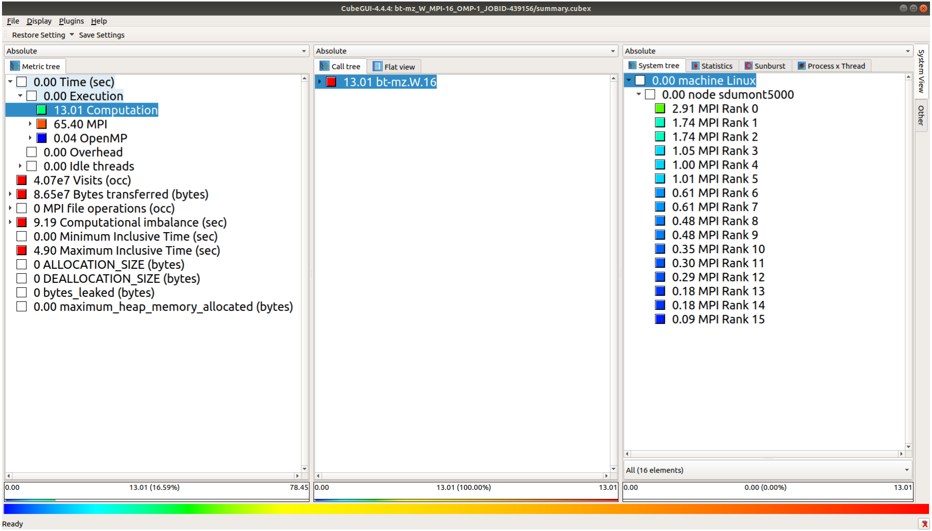
Balanço de carga de computação (LB):

$$LB = \frac{avg(tcomp)}{max(tcomp)}$$

FONTE: **`https://pop-coe.eu`**

Visualizando no Cube

–nodes=1 –ntasks=16



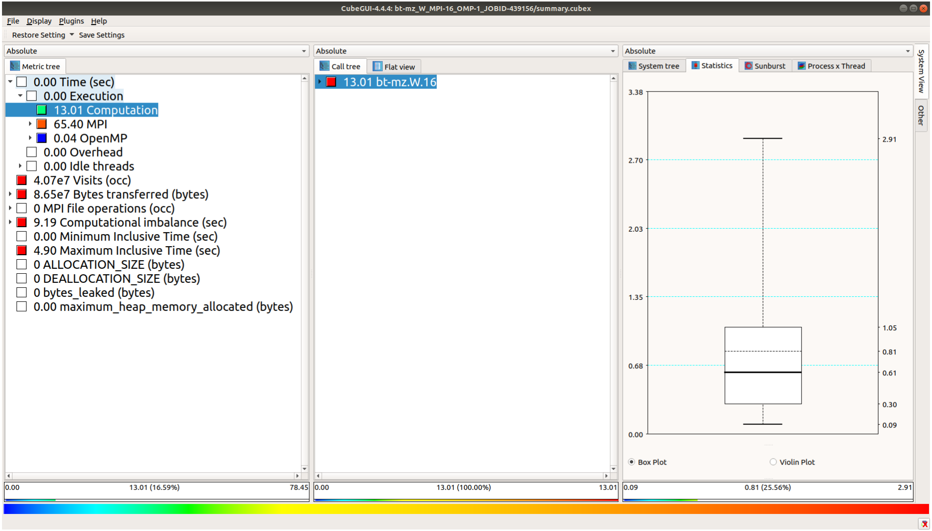
```
0.00 Time (sec)
  0.00 Execution
    13.01 Computation
    65.40 MPI
    0.04 OpenMP
  0.00 Overhead
  0.00 Idle threads
4.07e7 Visits (occ)
8.65e7 Bytes transferred (bytes)
0 MPI file operations (occ)
9.19 Computational imbalance (sec)
0.00 Minimum Inclusive Time (sec)
4.90 Maximum Inclusive Time (sec)
0 ALLOCATION_SIZE (bytes)
0 DEALLOCATION_SIZE (bytes)
0 bytes_leaked (bytes)
0.00 maximum_heap_memory_allocated (bytes)

0.00          13.01 (16.59%)          78.45
```

```
13.01 bt-mz.W.16

0.00          13.01 (100.00%)          13.01
```

```
0.00 machine Linux
  0.00 node sdumont5000
    2.91 MPI Rank 0
    1.74 MPI Rank 1
    1.74 MPI Rank 2
    1.05 MPI Rank 3
    1.00 MPI Rank 4
    1.01 MPI Rank 5
    0.61 MPI Rank 6
    0.61 MPI Rank 7
    0.48 MPI Rank 8
    0.48 MPI Rank 9
    0.35 MPI Rank 10
    0.30 MPI Rank 11
    0.29 MPI Rank 12
    0.18 MPI Rank 13
    0.18 MPI Rank 14
    0.09 MPI Rank 15

0.00          0.00 (0.00%)          13.01
```

Visualizando no Cube

-nodes=1 -ntasks=16



CubeGUI-4.4.4: bt-mz_W_MPI-16_OMP-1_JOBID-439156/summary.cubex

- ☐ 0.00 Time (sec)
  - ☐ 0.00 Execution
    - 🟩 13.01 Computation
    - 🟧 65.40 MPI
    - 🟦 0.04 OpenMP
  - ☐ 0.00 Overhead
  - ☐ 0.00 Idle threads
- 🟥 4.07e7 Visits (occ)
- 🟥 8.65e7 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- 🟥 9.19 Computational imbalance (sec)
- ☐ 0.00 Minimum Inclusive Time (sec)
- 🟥 4.90 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)

🟥 13.01 bt-mz.W.16

● Box Plot ○ Violin Plot

Scalasca

Cálculo

Balanço de carga de computação (LB)

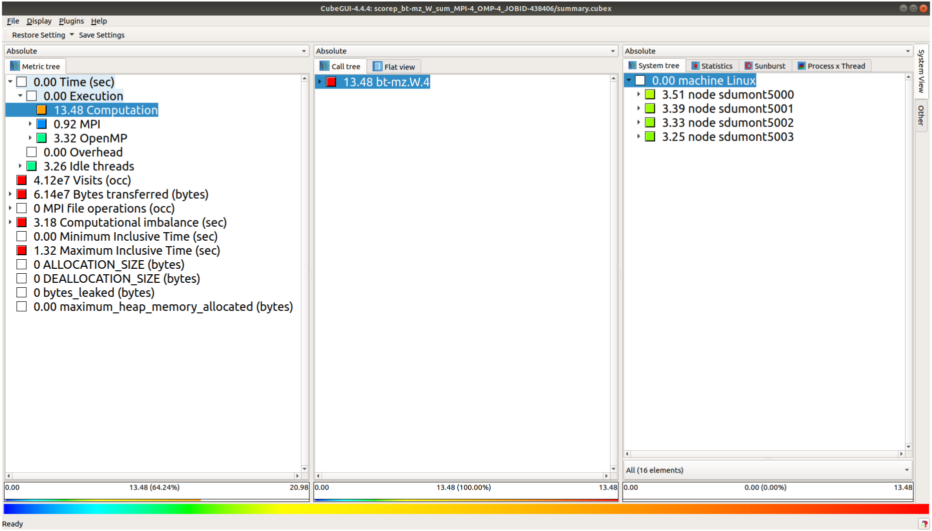
$$LB = \frac{avg(tcomp)}{max(tcomp)}$$

$$LB = \frac{0.81}{2.91}$$

$$LB = 0.28$$

Visualizando no Cube

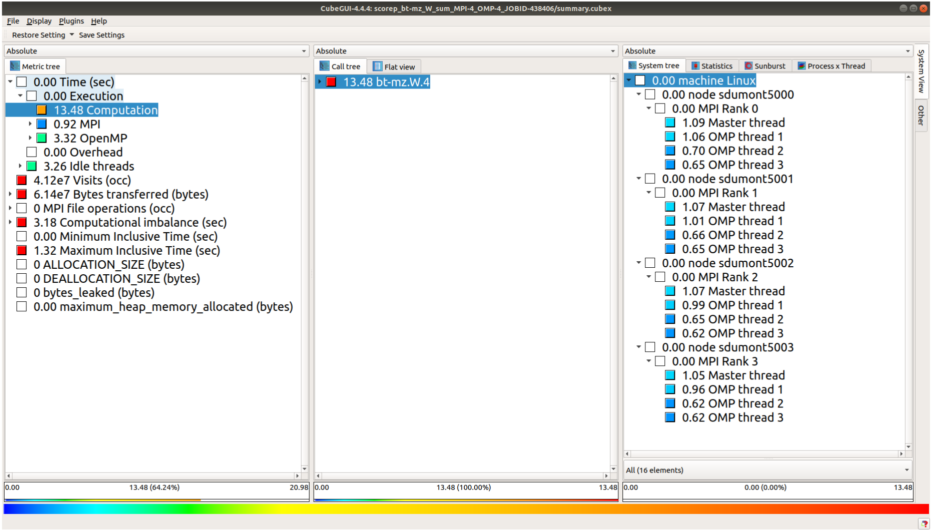
`-nodes=4 -ntasks=4 -cpus-per-task=4`



```
Metric tree:
▾ ☐ 0.00 Time (sec)
  ▾ ☐ 0.00 Execution
      ■ 13.48 Computation
    ▸ ■ 0.92 MPI
    ▸ ■ 3.32 OpenMP
    ☐ 0.00 Overhead
  ▸ ■ 3.26 Idle threads
  ■ 4.12e7 Visits (occ)
▸ ■ 6.14e7 Bytes transferred (bytes)
▸ ☐ 0 MPI file operations (occ)
▸ ■ 3.18 Computational imbalance (sec)
  ☐ 0.00 Minimum Inclusive Time (sec)
  ■ 1.32 Maximum Inclusive Time (sec)
  ☐ 0 ALLOCATION_SIZE (bytes)
  ☐ 0 DEALLOCATION_SIZE (bytes)
  ☐ 0 bytes_leaked (bytes)
  ☐ 0.00 maximum_heap_memory_allocated (bytes)

0.00        13.48 (64.24%)        20.98

Call tree:
▸ ■ 13.48 bt-mz.W.4

0.00        13.48 (100.00%)        13.48

System tree:
▾ ☐ 0.00 machine Linux
  ▸ ■ 3.51 node sdumont5000
  ▸ ■ 3.39 node sdumont5001
  ▸ ■ 3.33 node sdumont5002
  ▸ ■ 3.25 node sdumont5003

0.00        0.00 (0.00%)        13.48
```

Visualizando no Cube

`-nodes=4 -ntasks=4 -cpus-per-task=4`



Metric tree:

- ☐ 0.00 Time (sec)
  - ☐ 0.00 Execution
    - 🟧 13.48 Computation
    - 🟦 0.92 MPI
    - 🟩 3.32 OpenMP
  - ☐ 0.00 Overhead
  - 🟩 3.26 Idle threads
- 🟥 4.12e7 Visits (occ)
- 🟥 6.14e7 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- 🟥 3.18 Computational imbalance (sec)
- ☐ 0.00 Minimum Inclusive Time (sec)
- 🟥 1.32 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)

0.00 13.48 (64.24%) 20.98

Call tree:

- 🟥 13.48 bt-mz.W.4

0.00 13.48 (100.00%) 13.48

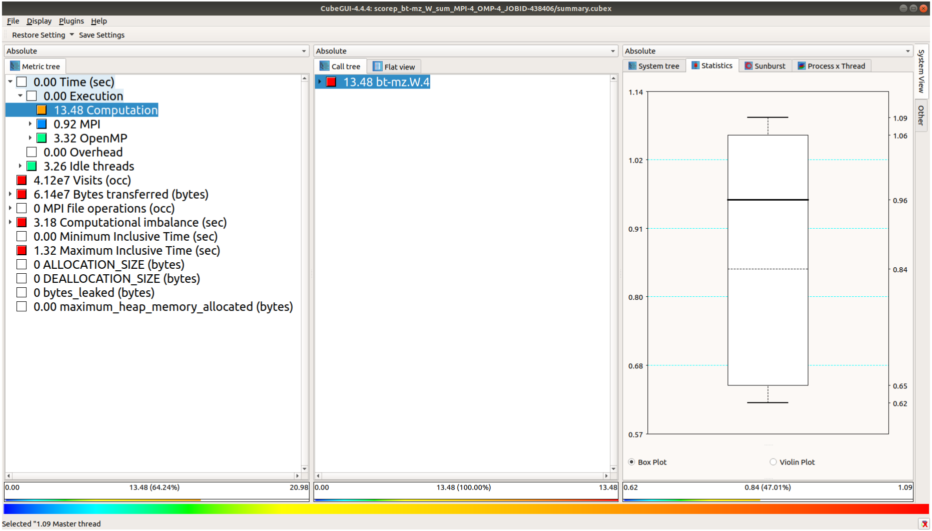
System tree:

- ☐ 0.00 machine Linux
  - ☐ 0.00 node sdumont5000
    - ☐ 0.00 MPI Rank 0
      - 1.09 Master thread
      - 1.06 OMP thread 1
      - 0.70 OMP thread 2
      - 0.65 OMP thread 3
  - ☐ 0.00 node sdumont5001
    - ☐ 0.00 MPI Rank 1
      - 1.07 Master thread
      - 1.01 OMP thread 1
      - 0.66 OMP thread 2
      - 0.65 OMP thread 3
  - ☐ 0.00 node sdumont5002
    - ☐ 0.00 MPI Rank 2
      - 1.07 Master thread
      - 0.99 OMP thread 1
      - 0.65 OMP thread 2
      - 0.62 OMP thread 3
  - ☐ 0.00 node sdumont5003
    - ☐ 0.00 MPI Rank 3
      - 1.05 Master thread
      - 0.96 OMP thread 1
      - 0.62 OMP thread 2
      - 0.62 OMP thread 3

0.00 0.00 (0.00%) 13.48

Visualizando no Cube

-nodes=4 -ntasks=4 -cpus-per-task=4



CubeGUI-4.4.4: scorep_bt-mz_W_sum_MPI-4_OMP-4_JOBID-438406/summary.cubex

Metric tree:

```
▾ ☐ 0.00 Time (sec)
  ▾ ☐ 0.00 Execution
      ■ 13.48 Computation
    ▸ ■ 0.92 MPI
    ▸ ■ 3.32 OpenMP
    ☐ 0.00 Overhead
  ▸ ■ 3.26 Idle threads
  ■ 4.12e7 Visits (occ)
▸ ■ 6.14e7 Bytes transferred (bytes)
▸ ☐ 0 MPI file operations (occ)
▸ ■ 3.18 Computational imbalance (sec)
  ☐ 0.00 Minimum Inclusive Time (sec)
  ■ 1.32 Maximum Inclusive Time (sec)
  ☐ 0 ALLOCATION_SIZE (bytes)
  ☐ 0 DEALLOCATION_SIZE (bytes)
  ☐ 0 bytes_leaked (bytes)
  ☐ 0.00 maximum_heap_memory_allocated (bytes)
```

Call tree:

```
▸ ■ 13.48 bt-mz.W.4
```

```
0.00        13.48 (64.24%)        20.98
0.00        13.48 (100.00%)       13.48
0.62        0.84 (47.01%)         1.09
```

● Box Plot ○ Violin Plot

Selected "1.09 Master thread

Scalasca

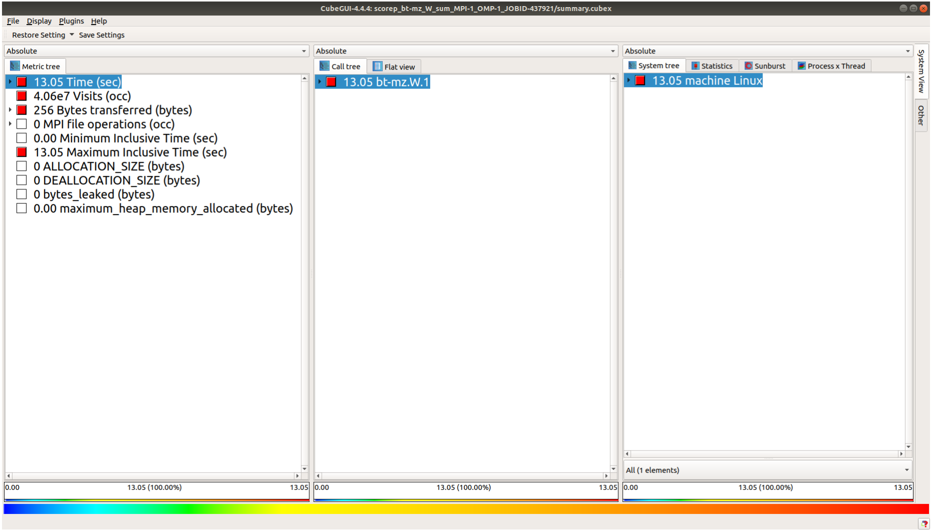
Cálculo

Balanço de carga de computação (LB)

$$LB = \frac{avg(tcomp)}{max(tcomp)}$$
$$LB = \frac{0.84}{1.09}$$
$$LB = 0.77$$

Visualizando no Cube

-nodes=1 -ntasks=1 / Absolute



CubeGUI-4.4.4: scorep_bt-mz_W_sum_MPI-1_OMP-1_JOBID-437921/summary.cubex

Absolute | Absolute | Absolute

🟥 13.05 Time (sec)
🟥 4.06e7 Visits (occ)
🟥 256 Bytes transferred (bytes)
☐ 0 MPI file operations (occ)
☐ 0.00 Minimum Inclusive Time (sec)
🟥 13.05 Maximum Inclusive Time (sec)
☐ 0 ALLOCATION_SIZE (bytes)
☐ 0 DEALLOCATION_SIZE (bytes)
☐ 0 bytes_leaked (bytes)
☐ 0.00 maximum_heap_memory_allocated (bytes)

🟥 13.05 bt-mz.W.1

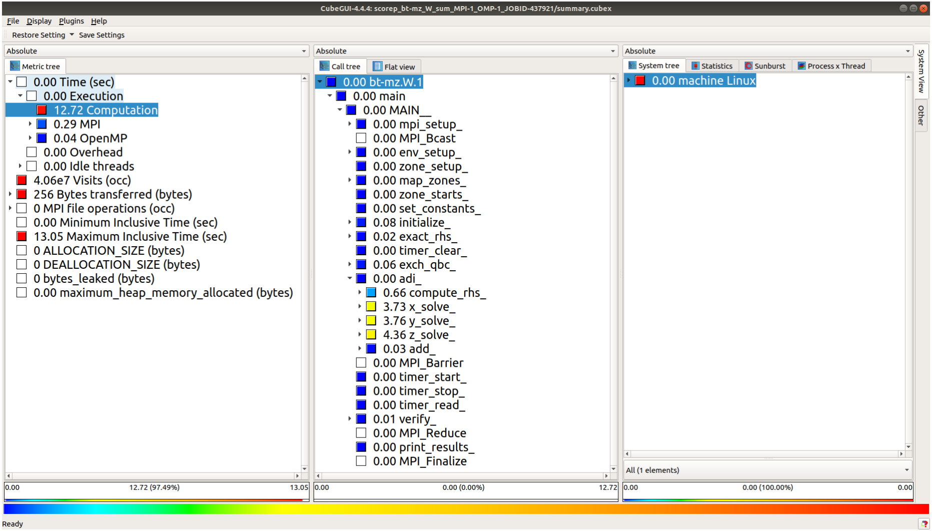
🟥 13.05 machine Linux

All (1 elements)

0.00 13.05 (100.00%) 13.05

Visualizando no Cube

-nodes=1 -ntasks=1 / Absolute



```
0.00 Time (sec)
  0.00 Execution
    12.72 Computation
    0.29 MPI
    0.04 OpenMP
  0.00 Overhead
  0.00 Idle threads
4.06e7 Visits (occ)
256 Bytes transferred (bytes)
0 MPI file operations (occ)
0.00 Minimum Inclusive Time (sec)
13.05 Maximum Inclusive Time (sec)
0 ALLOCATION_SIZE (bytes)
0 DEALLOCATION_SIZE (bytes)
0 bytes_leaked (bytes)
0.00 maximum_heap_memory_allocated (bytes)
```

```
0.00                12.72 (97.49%)                13.05
```

```
0.00 bt-mz.W.1
  0.00 main
    0.00 MAIN__
      0.00 mpi_setup_
      0.00 MPI_Bcast
      0.00 env_setup_
      0.00 zone_setup_
      0.00 map_zones_
      0.00 zone_starts_
      0.00 set_constants_
      0.08 initialize_
      0.02 exact_rhs_
      0.00 timer_clear_
      0.06 exch_qbc_
      0.00 adi_
        0.66 compute_rhs_
        3.73 x_solve_
        3.76 y_solve_
        4.36 z_solve_
        0.03 add_
      0.00 MPI_Barrier
      0.00 timer_start_
      0.00 timer_stop_
      0.00 timer_read_
      0.01 verify_
      0.00 MPI_Reduce
      0.00 print_results_
      0.00 MPI_Finalize
```

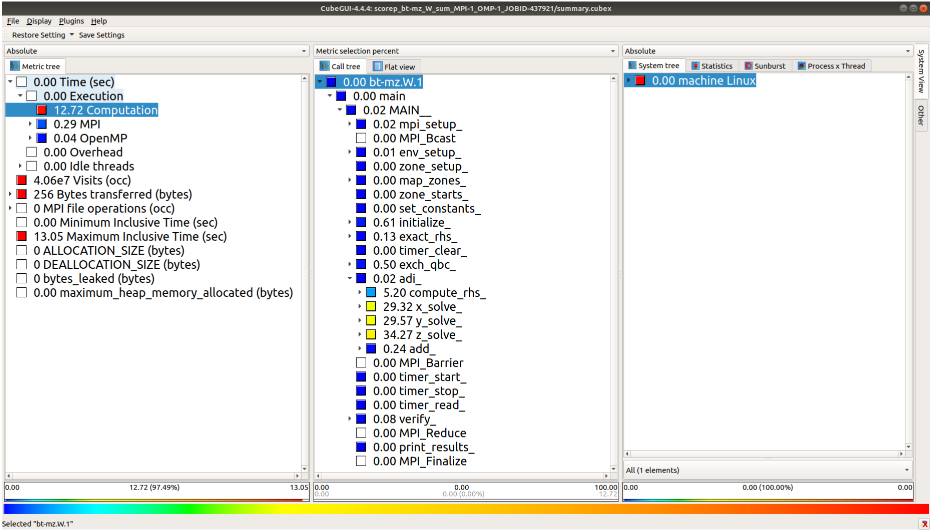
```
0.00                0.00 (0.00%)                12.72
```

```
0.00 machine Linux
```

```
0.00                0.00 (100.00%)                0.00
```

Visualizando no Cube

-nodes=1 -ntasks=1 / Metric Own percent



- ☐ 0.00 Time (sec)
  - ☐ 0.00 Execution
    - 🟥 12.72 Computation
    - 🟦 0.29 MPI
    - 🟦 0.04 OpenMP
  - ☐ 0.00 Overhead
  - ☐ 0.00 Idle threads
- 🟥 4.06e7 Visits (occ)
- 🟥 256 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- ☐ 0.00 Minimum Inclusive Time (sec)
- 🟥 13.05 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)

- 🟦 0.00 bt-mz.W.1
  - 🟦 0.00 main
    - 🟦 0.02 MAIN__
      - 🟦 0.02 mpi_setup_
      - ☐ 0.00 MPI_Bcast
      - 🟦 0.01 env_setup_
      - 🟦 0.00 zone_setup_
      - 🟦 0.00 map_zones_
      - 🟦 0.00 zone_starts_
      - 🟦 0.00 set_constants_
      - 🟦 0.61 initialize_
      - 🟦 0.13 exact_rhs_
      - 🟦 0.00 timer_clear_
      - 🟦 0.50 exch_qbc_
      - 🟦 0.02 adi_
        - 🟦 5.20 compute_rhs_
        - 🟨 29.32 x_solve_
        - 🟨 29.57 y_solve_
        - 🟨 34.27 z_solve_
        - 🟦 0.24 add_
      - ☐ 0.00 MPI_Barrier
      - 🟦 0.00 timer_start_
      - 🟦 0.00 timer_stop_
      - 🟦 0.00 timer_read_
      - 🟦 0.08 verify_
      - ☐ 0.00 MPI_Reduce
      - 🟦 0.00 print_results_
      - ☐ 0.00 MPI_Finalize

- 🟥 0.00 machine Linux

0.00 12.72 (97.49%) 13.05

0.00 0.00 100.00
0.00 0.00 (0.00%) 12.72

0.00 0.00 (100.00%) 0.00

Selected "bt-mz.W.1"

Visualizando no Cube

3 hotspots de computação

- **`x_solve`**: 3.73s (29.32%)
- **`y_solve`**: 3.76s (29.57%)
- **`z_solve`**: 4.36s (34.27%)

Medindo contadores de hardware (PAPI)

É possível obter acessar contadores de hardware (hwc) por meio da biblioteca PAPI (**`https://icl.utk.edu/papi/`**)
Para saber os contadores disponíveis, dar o comanto **`papi_avail`**:

```
$ module load papi/5.5.1.0
$ papi_avail

Available PAPI preset and user defined events plus hardware information.
--------------------------------------------------------------------------------
PAPI Version             : 5.5.1.0
Vendor string and code   : GenuineIntel (1)
Model string and code    : Intel(R) Xeon(R) CPU E5-2695 v2 @ 2.40GHz (62)
CPU Revision             : 4.000000
CPUID Info               : Family: 6  Model: 62  Stepping: 4
CPU Max Megahertz        : 2401
CPU Min Megahertz        : 1200
Hdw Threads per core     : 1
Cores per Socket         : 12
Sockets                  : 2
NUMA Nodes               : 2
CPUs per Node            : 12
Total CPUs               : 24
Running in a VM          : no
Number Hardware Counters : 11
Max Multiplex Counters   : 32
--------------------------------------------------------------------------------
```

Medindo contadores de hardware (PAPI) (cont.)

```
================================================================================
  PAPI Preset Events
================================================================================
    Name        Code    Avail Deriv Description (Note)
PAPI_L1_DCM  0x80000000  Yes   No    Level 1 data cache misses
PAPI_L1_ICM  0x80000001  Yes   No    Level 1 instruction cache misses
PAPI_L2_DCM  0x80000002  Yes   Yes   Level 2 data cache misses
PAPI_L2_ICM  0x80000003  Yes   No    Level 2 instruction cache misses
PAPI_L3_DCM  0x80000004  No    No    Level 3 data cache misses
PAPI_L3_ICM  0x80000005  No    No    Level 3 instruction cache misses
PAPI_L1_TCM  0x80000006  Yes   Yes   Level 1 cache misses
PAPI_L2_TCM  0x80000007  Yes   No    Level 2 cache misses
PAPI_L3_TCM  0x80000008  Yes   No    Level 3 cache misses
PAPI_CA_SNP  0x80000009  No    No    Requests for a snoop
PAPI_CA_SHR  0x8000000a  No    No    Requests for exclusive access to shared cache line
PAPI_CA_CLN  0x8000000b  No    No    Requests for exclusive access to clean cache line
PAPI_CA_INV  0x8000000c  No    No    Requests for cache line invalidation
PAPI_CA_ITV  0x8000000d  No    No    Requests for cache line intervention
PAPI_L3_LDM  0x8000000e  No    No    Level 3 load misses
PAPI_L3_STM  0x8000000f  No    No    Level 3 store misses
PAPI_BRU_IDL 0x80000010  No    No    Cycles branch units are idle
PAPI_FXU_IDL 0x80000011  No    No    Cycles integer units are idle
PAPI_FPU_IDL 0x80000012  No    No    Cycles floating point units are idle
PAPI_LSU_IDL 0x80000013  No    No    Cycles load/store units are idle
PAPI_TLB_DM  0x80000014  Yes   Yes   Data translation lookaside buffer misses
PAPI_TLB_IM  0x80000015  Yes   No    Instruction translation lookaside buffer misses
PAPI_TLB_TL  0x80000016  No    No    Total translation lookaside buffer misses
PAPI_L1_LDM  0x80000017  Yes   No    Level 1 load misses
PAPI_L1_STM  0x80000018  Yes   No    Level 1 store misses
PAPI_L2_LDM  0x80000019  No    No    Level 2 load misses
```

Medindo contadores de hardware (PAPI) (cont.)

```
PAPI_L2_STM  0x8000001a  Yes   No   Level 2 store misses
PAPI_BTAC_M  0x8000001b  No    No   Branch target address cache misses
PAPI_PRF_DM  0x8000001c  No    No   Data prefetch cache misses
PAPI_L3_DCH  0x8000001d  No    No   Level 3 data cache hits
PAPI_TLB_SD  0x8000001e  No    No   Translation lookaside buffer shootdowns
PAPI_CSR_FAL 0x8000001f  No    No   Failed store conditional instructions
PAPI_CSR_SUC 0x80000020  No    No   Successful store conditional instructions
PAPI_CSR_TOT 0x80000021  No    No   Total store conditional instructions
PAPI_MEM_SCY 0x80000022  No    No   Cycles Stalled Waiting for memory accesses
PAPI_MEM_RCY 0x80000023  No    No   Cycles Stalled Waiting for memory Reads
PAPI_MEM_WCY 0x80000024  No    No   Cycles Stalled Waiting for memory writes
PAPI_STL_ICY 0x80000025  Yes   No   Cycles with no instruction issue
PAPI_FUL_ICY 0x80000026  No    No   Cycles with maximum instruction issue
PAPI_STL_CCY 0x80000027  No    No   Cycles with no instructions completed
PAPI_FUL_CCY 0x80000028  No    No   Cycles with maximum instructions completed
PAPI_HW_INT  0x80000029  No    No   Hardware interrupts
PAPI_BR_UCN  0x8000002a  Yes   Yes  Unconditional branch instructions
PAPI_BR_CN   0x8000002b  Yes   No   Conditional branch instructions
PAPI_BR_TKN  0x8000002c  Yes   Yes  Conditional branch instructions taken
PAPI_BR_NTK  0x8000002d  Yes   No   Conditional branch instructions not taken
PAPI_BR_MSP  0x8000002e  Yes   No   Conditional branch instructions mispredicted
PAPI_BR_PRC  0x8000002f  Yes   Yes  Conditional branch instructions correctly predicted
PAPI_FMA_INS 0x80000030  No    No   FMA instructions completed
PAPI_TOT_IIS 0x80000031  No    No   Instructions issued
PAPI_TOT_INS 0x80000032  Yes   No   Instructions completed
PAPI_INT_INS 0x80000033  No    No   Integer instructions
PAPI_FP_INS  0x80000034  Yes   Yes  Floating point instructions
PAPI_LD_INS  0x80000035  Yes   No   Load instructions
PAPI_SR_INS  0x80000036  Yes   No   Store instructions
PAPI_BR_INS  0x80000037  Yes   No   Branch instructions
```

Medindo contadores de hardware (PAPI) (cont.)

```
PAPI_VEC_INS 0x80000038  No    No   Vector/SIMD instructions (could include integer)
PAPI_RES_STL 0x80000039  No    No   Cycles stalled on any resource
PAPI_FP_STAL 0x8000003a  No    No   Cycles the FP unit(s) are stalled
PAPI_TOT_CYC 0x8000003b  Yes   No   Total cycles
PAPI_LST_INS 0x8000003c  No    No   Load/store instructions completed
PAPI_SYC_INS 0x8000003d  No    No   Synchronization instructions completed
PAPI_L1_DCH  0x8000003e  No    No   Level 1 data cache hits
PAPI_L2_DCH  0x8000003f  Yes   Yes  Level 2 data cache hits
PAPI_L1_DCA  0x80000040  No    No   Level 1 data cache accesses
PAPI_L2_DCA  0x80000041  Yes   No   Level 2 data cache accesses
PAPI_L3_DCA  0x80000042  Yes   Yes  Level 3 data cache accesses
PAPI_L1_DCR  0x80000043  No    No   Level 1 data cache reads
PAPI_L2_DCR  0x80000044  Yes   No   Level 2 data cache reads
PAPI_L3_DCR  0x80000045  Yes   No   Level 3 data cache reads
PAPI_L1_DCW  0x80000046  No    No   Level 1 data cache writes
PAPI_L2_DCW  0x80000047  Yes   No   Level 2 data cache writes
PAPI_L3_DCW  0x80000048  Yes   No   Level 3 data cache writes
PAPI_L1_ICH  0x80000049  No    No   Level 1 instruction cache hits
PAPI_L2_ICH  0x8000004a  Yes   No   Level 2 instruction cache hits
PAPI_L3_ICH  0x8000004b  No    No   Level 3 instruction cache hits
PAPI_L1_ICA  0x8000004c  No    No   Level 1 instruction cache accesses
PAPI_L2_ICA  0x8000004d  Yes   No   Level 2 instruction cache accesses
PAPI_L3_ICA  0x8000004e  Yes   No   Level 3 instruction cache accesses
PAPI_L1_ICR  0x8000004f  No    No   Level 1 instruction cache reads
PAPI_L2_ICR  0x80000050  Yes   No   Level 2 instruction cache reads
PAPI_L3_ICR  0x80000051  Yes   No   Level 3 instruction cache reads
PAPI_L1_ICW  0x80000052  No    No   Level 1 instruction cache writes
PAPI_L2_ICW  0x80000053  No    No   Level 2 instruction cache writes
PAPI_L3_ICW  0x80000054  No    No   Level 3 instruction cache writes
PAPI_L1_TCH  0x80000055  No    No   Level 1 total cache hits
```

Medindo contadores de hardware (PAPI) (cont.)

```
PAPI_L2_TCH  0x80000056  No    No   Level 2 total cache hits
PAPI_L3_TCH  0x80000057  No    No   Level 3 total cache hits
PAPI_L1_TCA  0x80000058  No    No   Level 1 total cache accesses
PAPI_L2_TCA  0x80000059  Yes   Yes  Level 2 total cache accesses
PAPI_L3_TCA  0x8000005a  Yes   No   Level 3 total cache accesses
PAPI_L1_TCR  0x8000005b  No    No   Level 1 total cache reads
PAPI_L2_TCR  0x8000005c  Yes   Yes  Level 2 total cache reads
PAPI_L3_TCR  0x8000005d  Yes   Yes  Level 3 total cache reads
PAPI_L1_TCW  0x8000005e  No    No   Level 1 total cache writes
PAPI_L2_TCW  0x8000005f  Yes   No   Level 2 total cache writes
PAPI_L3_TCW  0x80000060  Yes   No   Level 3 total cache writes
PAPI_FML_INS 0x80000061  No    No   Floating point multiply instructions
PAPI_FAD_INS 0x80000062  No    No   Floating point add instructions
PAPI_FDV_INS 0x80000063  Yes   No   Floating point divide instructions
PAPI_FSQ_INS 0x80000064  No    No   Floating point square root instructions
PAPI_FNV_INS 0x80000065  No    No   Floating point inverse instructions
PAPI_FP_OPS  0x80000066  Yes   Yes  Floating point operations
PAPI_SP_OPS  0x80000067  Yes   Yes  Floating point operations; optimized to count scaled single pr
PAPI_DP_OPS  0x80000068  Yes   Yes  Floating point operations; optimized to count scaled double pr
PAPI_VEC_SP  0x80000069  Yes   Yes  Single precision vector/SIMD instructions
PAPI_VEC_DP  0x8000006a  Yes   Yes  Double precision vector/SIMD instructions
PAPI_REF_CYC 0x8000006b  Yes   No   Reference clock cycles
--------------------------------------------------------------------------------
Of 108 possible events, 50 are available, of which 17 are derived.

avail.c                                     PASSED
```

Medindo contadores de hardware (PAPI)

Contadores a serem utilizados

```
PAPI_TOT_INS 0x80000032  Yes   No   Instructions completed
PAPI_TOT_CYC 0x8000003b  Yes   No   Total cycles

PAPI_L2_DCM  0x80000002  Yes   Yes  Level 2 data cache misses
PAPI_L2_DCA  0x80000041  Yes   No   Level 2 data cache accesses
```

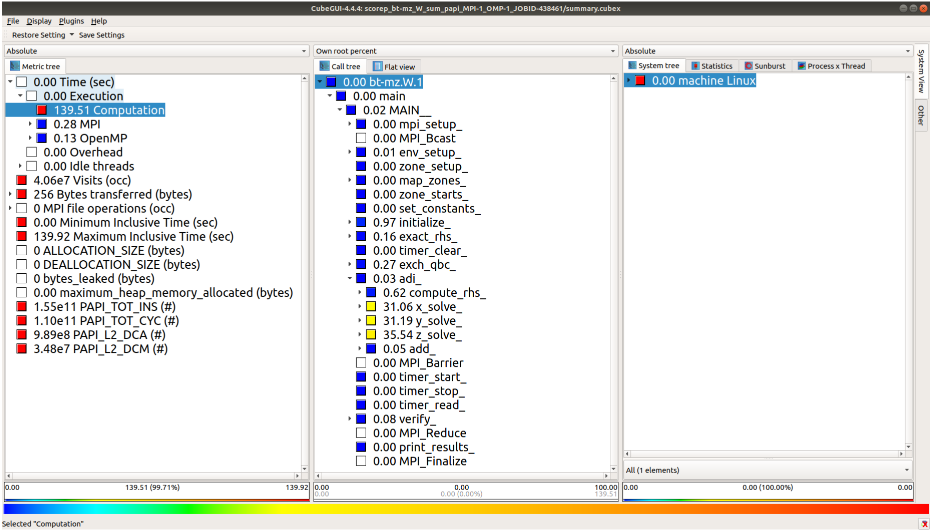
Medindo contadores de hardware (PAPI)

Definindo a variável de ambiente do Scalasca **`SCOREP_METRIC_PAPI`**.

`BULL_srun_scalasca.sh`

Medindo contadores de hardware (PAPI)

`-nodes=1 -ntasks=1 / BT-MZ.W`



CubeGUI-4.4.4: scorep_bt-mz_W_sum_papi_MPI-1_OMP-1_JOBID-438461/summary.cubex
File Display Plugins Help
Restore Setting Save Settings
Absolute
Metric tree
Own root percent
Call tree
Flat view
Absolute
System tree
Statistics
Sunburst
Process x Thread
System View
Other

```
▾ ☐ 0.00 Time (sec)
  ▾ ☐ 0.00 Execution
      🟥 139.51 Computation
    ▸ 🟦 0.28 MPI
    ▸ 🟦 0.13 OpenMP
    ☐ 0.00 Overhead
  ▸ ☐ 0.00 Idle threads
  🟥 4.06e7 Visits (occ)
▸ 🟥 256 Bytes transferred (bytes)
▸ ☐ 0 MPI file operations (occ)
  🟥 0.00 Minimum Inclusive Time (sec)
  🟥 139.92 Maximum Inclusive Time (sec)
  ☐ 0 ALLOCATION_SIZE (bytes)
  ☐ 0 DEALLOCATION_SIZE (bytes)
  ☐ 0 bytes_leaked (bytes)
  ☐ 0.00 maximum_heap_memory_allocated (bytes)
  🟥 1.55e11 PAPI_TOT_INS (#)
  🟥 1.10e11 PAPI_TOT_CYC (#)
  🟥 9.89e8 PAPI_L2_DCA (#)
  🟥 3.48e7 PAPI_L2_DCM (#)
```

```
▾ 🟦 0.00 bt-mz.W.1
  ▾ 🟦 0.00 main
    ▾ 🟦 0.02 MAIN__
      ▸ 🟦 0.00 mpi_setup_
        ☐ 0.00 MPI_Bcast
      ▸ 🟦 0.01 env_setup_
        🟦 0.00 zone_setup_
      ▸ 🟦 0.00 map_zones_
        🟦 0.00 zone_starts_
        🟦 0.00 set_constants_
      ▸ 🟦 0.97 initialize_
      ▸ 🟦 0.16 exact_rhs_
        🟦 0.00 timer_clear_
      ▸ 🟦 0.27 exch_qbc_
      ▾ 🟦 0.03 adi_
        ▸ 🟦 0.62 compute_rhs_
        ▸ 🟨 31.06 x_solve_
        ▸ 🟨 31.19 y_solve_
        ▸ 🟨 35.54 z_solve_
        ▸ 🟦 0.05 add_
        ☐ 0.00 MPI_Barrier
        🟦 0.00 timer_start_
        🟦 0.00 timer_stop_
        🟦 0.00 timer_read_
      ▸ 🟦 0.08 verify_
        ☐ 0.00 MPI_Reduce
        🟦 0.00 print_results_
        ☐ 0.00 MPI_Finalize
```

```
▸ 🟥 0.00 machine Linux
```

All (1 elements)

```
0.00          139.51 (99.71%)          139.92
0.00               0.00                100.00
0.00            0.00 (0.00%)           139.51
0.00          0.00 (100.00%)             0.00
```

Selected "Computation"

Medindo contadores de hardware (PAPI)

`-nodes=1 -ntasks=1 / BT-MZ.W`

- Tempo de processamento aproximadamente 10X maior!

Medindo contadores de hardware (PAPI)

`-nodes=1 -ntasks=1 / BT-MZ.W`

- Tempo de processamento aproximadamente 10X maior!
- *Overhead* (custo adicional) devido a PAPI.

Medindo contadores de hardware (PAPI)

`-nodes=1 -ntasks=1 / BT-MZ.W`

- Tempo de processamento aproximadamente 10X maior!
- *Overhead* (custo adicional) devido a PAPI.
- Rodar em uma instância menor do problema: **`BT-MZ.S`**

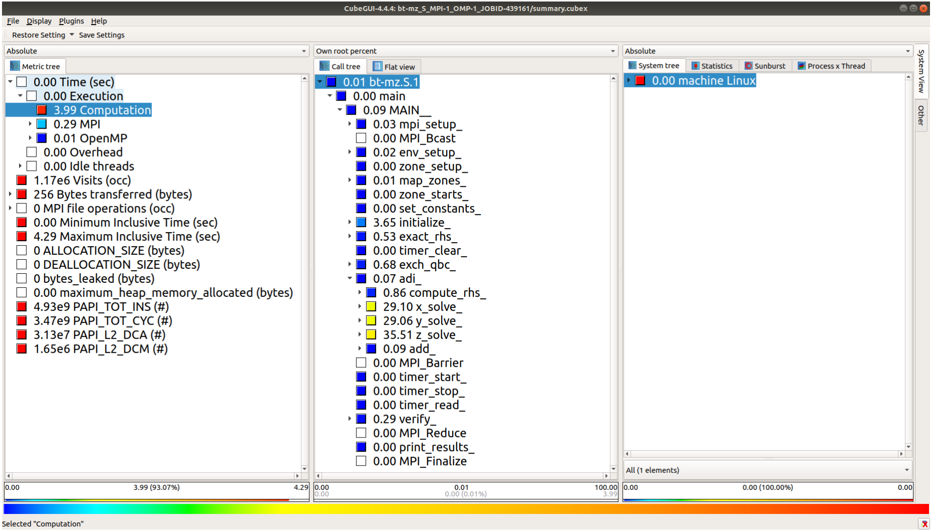
Medindo contadores de hardware (PAPI)

`-nodes=1 -ntasks=1 / BT-MZ.W`

- Tempo de processamento aproximadamente 10X maior!
- *Overhead* (custo adicional) devido a PAPI.
- Rodar em uma instância menor do problema: **`BT-MZ.S`**
- O perfil de desempenho muitas vezes é similar.

Medindo contadores de hardware (PAPI)

`-nodes=1 -ntasks=1 / BT-MZ.S`



```
0.00 Time (sec)
  0.00 Execution
    3.99 Computation
    0.29 MPI
    0.01 OpenMP
  0.00 Overhead
  0.00 Idle threads
1.17e6 Visits (occ)
256 Bytes transferred (bytes)
0 MPI file operations (occ)
0.00 Minimum Inclusive Time (sec)
4.29 Maximum Inclusive Time (sec)
0 ALLOCATION_SIZE (bytes)
0 DEALLOCATION_SIZE (bytes)
0 bytes_leaked (bytes)
0.00 maximum_heap_memory_allocated (bytes)
4.93e9 PAPI_TOT_INS (#)
3.47e9 PAPI_TOT_CYC (#)
3.13e7 PAPI_L2_DCA (#)
1.65e6 PAPI_L2_DCM (#)
```

```
0.01 bt-mz.S.1
  0.00 main
    0.09 MAIN__
      0.03 mpi_setup_
      0.00 MPI_Bcast
      0.02 env_setup_
      0.00 zone_setup_
      0.01 map_zones_
      0.00 zone_starts_
      0.00 set_constants_
      3.65 initialize_
      0.53 exact_rhs_
      0.00 timer_clear_
      0.68 exch_qbc_
      0.07 adi_
        0.86 compute_rhs_
        29.10 x_solve_
        29.06 y_solve_
        35.51 z_solve_
        0.09 add_
      0.00 MPI_Barrier
      0.00 timer_start_
      0.00 timer_stop_
      0.00 timer_read_
      0.29 verify_
      0.00 MPI_Reduce
      0.00 print_results_
      0.00 MPI_Finalize
```

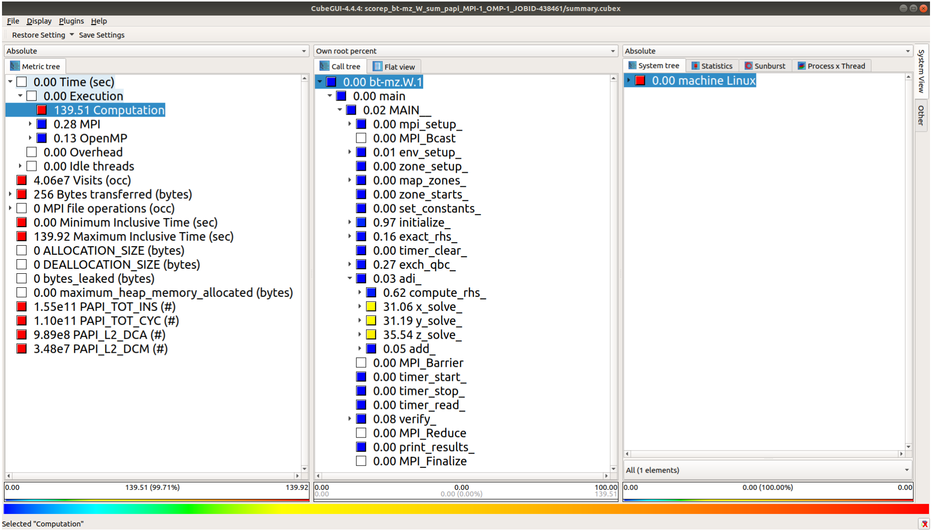
```
0.00 machine Linux
```

```
0.00          3.99 (93.07%)          4.29
0.00              0.01             100.00
0.00          0.00 (0.01%)           3.99
0.00          0.00 (100.00%)         0.00
```

Selected "Computation"

Medindo contadores de hardware (PAPI)

–nodes=1 –ntasks=1 / BT-MZ.W



CubeGUI-4.4.4: scorep_bt-mz_W_sum_papi_MPI-1_OMP-1_JOBID-438461/summary.cubex

Metric tree:

- ☐ 0.00 Time (sec)
  - ☐ 0.00 Execution
    - 🟥 139.51 Computation
    - 🟦 0.28 MPI
    - 🟦 0.13 OpenMP
  - ☐ 0.00 Overhead
  - ☐ 0.00 Idle threads
- 🟥 4.06e7 Visits (occ)
- 🟥 256 Bytes transferred (bytes)
- ☐ 0 MPI file operations (occ)
- 🟥 0.00 Minimum Inclusive Time (sec)
- 🟥 139.92 Maximum Inclusive Time (sec)
- ☐ 0 ALLOCATION_SIZE (bytes)
- ☐ 0 DEALLOCATION_SIZE (bytes)
- ☐ 0 bytes_leaked (bytes)
- ☐ 0.00 maximum_heap_memory_allocated (bytes)
- 🟥 1.55e11 PAPI_TOT_INS (#)
- 🟥 1.10e11 PAPI_TOT_CYC (#)
- 🟥 9.89e8 PAPI_L2_DCA (#)
- 🟥 3.48e7 PAPI_L2_DCM (#)

Call tree:

- 🟦 0.00 bt-mz.W.1
  - 🟦 0.00 main
    - 🟦 0.02 MAIN__
      - 🟦 0.00 mpi_setup_
      - ☐ 0.00 MPI_Bcast
      - 🟦 0.01 env_setup_
      - 🟦 0.00 zone_setup_
      - 🟦 0.00 map_zones_
      - 🟦 0.00 zone_starts_
      - 🟦 0.00 set_constants_
      - 🟦 0.97 initialize_
      - 🟦 0.16 exact_rhs_
      - 🟦 0.00 timer_clear_
      - 🟦 0.27 exch_qbc_
      - 🟦 0.03 adi_
        - 🟦 0.62 compute_rhs_
        - 🟨 31.06 x_solve_
        - 🟨 31.19 y_solve_
        - 🟨 35.54 z_solve_
        - 🟦 0.05 add_
      - ☐ 0.00 MPI_Barrier
      - 🟦 0.00 timer_start_
      - 🟦 0.00 timer_stop_
      - 🟦 0.00 timer_read_
      - 🟦 0.08 verify_
      - ☐ 0.00 MPI_Reduce
      - 🟦 0.00 print_results_
      - ☐ 0.00 MPI_Finalize

System tree:

- 🟥 0.00 machine Linux

All (1 elements)

0.00 139.51 (99.71%) 139.92

0.00 0.00 0.00 (0.00%) 100.00 139.51

0.00 0.00 (100.00%) 0.00

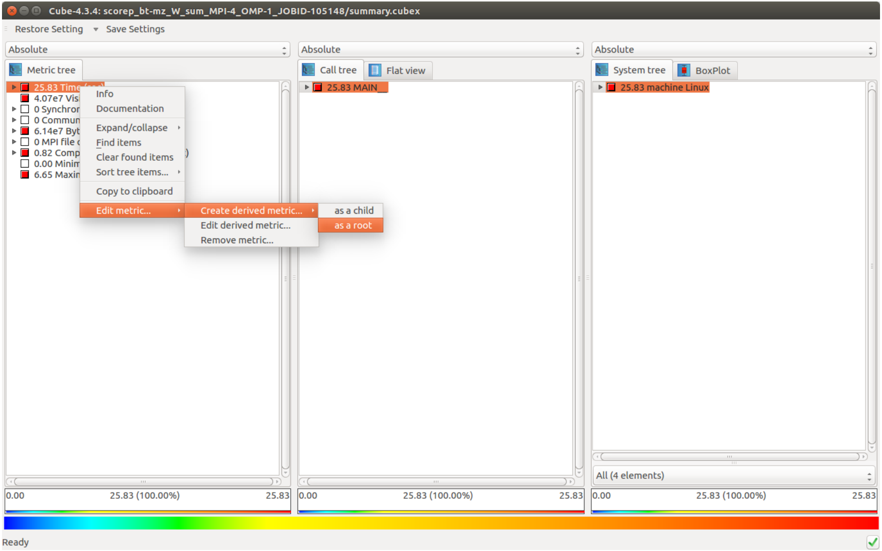
Selected "Computation"

Medindo contadores de hardware (PAPI)

Cálculo de novas métricas

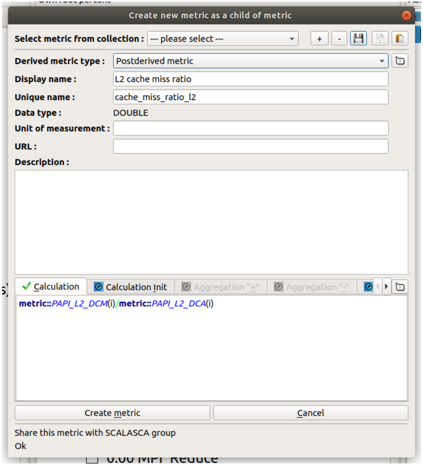
```
Razão de cache miss L2:
  L2 cache miss ratio = PAPI_L2_DCM/PAPI_L2_DCA

Instruções por ciclo (IPC):
  IPC = PAPI_TOT_INS/PAPI_TOT_CYC
```

Criando nova métrica no Cube



Criando nova métrica no Cube

`metric::PAPI_L2_DCM(i)/metric::PAPI_L2_DCA(i)`



Select metric from collection : --- please select ---

Derived metric type : Postderived metric

Display name : L2 cache miss ratio

Unique name : cache_miss_ratio_l2

Data type : DOUBLE

Unit of measurement :

URL :

Description :

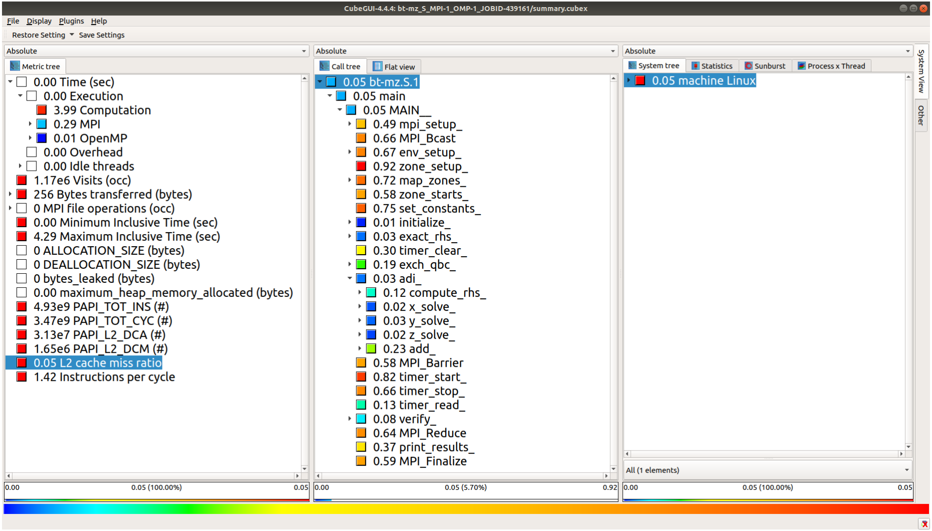
✓ Calculation | Calculation Init | Aggregation "+" | Aggregation "-"

```
metric::PAPI_L2_DCM(i)/metric::PAPI_L2_DCA(i)
```

Share this metric with SCALASCA group
Ok

Criando nova métrica no Cube

`L2 cache miss ratio / BT-MZ.S`



```
0.00 Time (sec)
  0.00 Execution
    3.99 Computation
    0.29 MPI
    0.01 OpenMP
  0.00 Overhead
  0.00 Idle threads
1.17e6 Visits (occ)
256 Bytes transferred (bytes)
0 MPI file operations (occ)
0.00 Minimum Inclusive Time (sec)
4.29 Maximum Inclusive Time (sec)
0 ALLOCATION_SIZE (bytes)
0 DEALLOCATION_SIZE (bytes)
0 bytes_leaked (bytes)
0.00 maximum_heap_memory_allocated (bytes)
4.93e9 PAPI_TOT_INS (#)
3.47e9 PAPI_TOT_CYC (#)
3.13e7 PAPI_L2_DCA (#)
1.65e6 PAPI_L2_DCM (#)
0.05 L2 cache miss ratio
1.42 Instructions per cycle
```

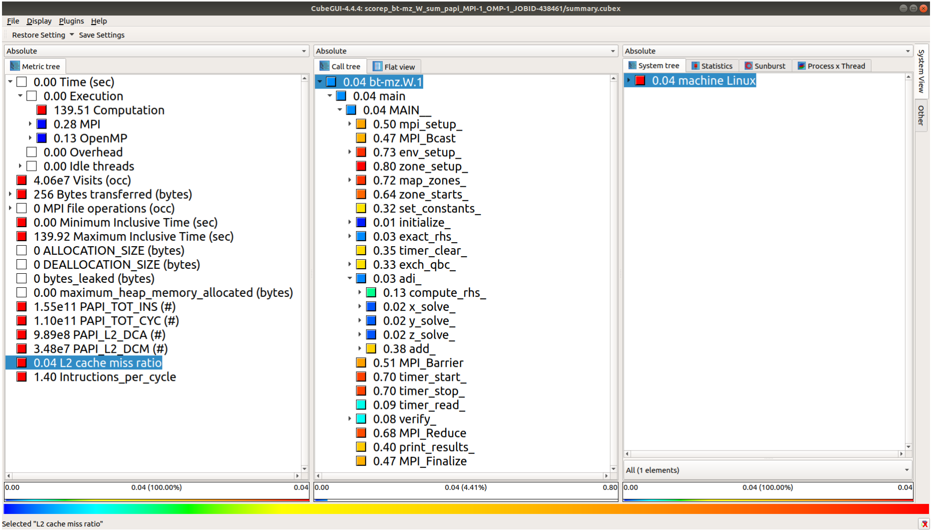
```
0.05 bt-mz.S.1
  0.05 main
    0.05 MAIN__
      0.49 mpi_setup_
      0.66 MPI_Bcast
      0.67 env_setup_
      0.92 zone_setup_
      0.72 map_zones_
      0.58 zone_starts_
      0.75 set_constants_
      0.01 initialize_
      0.03 exact_rhs_
      0.30 timer_clear_
      0.19 exch_qbc_
      0.03 adi_
        0.12 compute_rhs_
        0.02 x_solve_
        0.03 y_solve_
        0.02 z_solve_
        0.23 add_
      0.58 MPI_Barrier
      0.82 timer_start_
      0.66 timer_stop_
      0.13 timer_read_
      0.08 verify_
      0.64 MPI_Reduce
      0.37 print_results_
      0.59 MPI_Finalize
```

```
0.05 machine Linux
```

```
0.00          0.05 (100.00%)          0.05
0.00          0.05 (5.70%)            0.92
0.00          0.05 (100.00%)          0.05
```

Criando nova métrica no Cube

L2 cache miss ratio / BT-MZ.W


CubeGUI-4.4.4: scorep_bt-mz_W_sum_papi_MPI-1_OMP-1_JOBID-438461/summary.cubex
File Display Plugins Help
Restore Setting Save Settings
Absolute
Metric tree
Absolute
Call tree
Flat view
Absolute
System tree
Statistics
Sunburst
Process x Thread
System View
Other

- 0.00 Time (sec)
  - 0.00 Execution
    - 139.51 Computation
    - 0.28 MPI
    - 0.13 OpenMP
  - 0.00 Overhead
  - 0.00 Idle threads
- 4.06e7 Visits (occ)
- 256 Bytes transferred (bytes)
- 0 MPI file operations (occ)
- 0.00 Minimum Inclusive Time (sec)
- 139.92 Maximum Inclusive Time (sec)
- 0 ALLOCATION_SIZE (bytes)
- 0 DEALLOCATION_SIZE (bytes)
- 0 bytes_leaked (bytes)
- 0.00 maximum_heap_memory_allocated (bytes)
- 1.55e11 PAPI_TOT_INS (#)
- 1.10e11 PAPI_TOT_CYC (#)
- 9.89e8 PAPI_L2_DCA (#)
- 3.48e7 PAPI_L2_DCM (#)
- 0.04 L2 cache miss ratio
- 1.40 Intructions_per_cycle

- 0.04 bt-mz.W.1
  - 0.04 main
    - 0.04 MAIN__
      - 0.50 mpi_setup_
      - 0.47 MPI_Bcast
      - 0.73 env_setup_
      - 0.80 zone_setup_
      - 0.72 map_zones_
      - 0.64 zone_starts_
      - 0.32 set_constants_
      - 0.01 initialize_
      - 0.03 exact_rhs_
      - 0.35 timer_clear_
      - 0.33 exch_qbc_
      - 0.03 adi_
        - 0.13 compute_rhs_
        - 0.02 x_solve_
        - 0.02 y_solve_
        - 0.02 z_solve_
        - 0.38 add_
      - 0.51 MPI_Barrier
      - 0.70 timer_start_
      - 0.70 timer_stop_
      - 0.09 timer_read_
      - 0.08 verify_
      - 0.68 MPI_Reduce
      - 0.40 print_results_
      - 0.47 MPI_Finalize

- 0.04 machine Linux

All (1 elements)

0.00 0.04 (100.00%) 0.04

0.00 0.04 (4.41%) 0.80

0.00 0.04 (100.00%) 0.04

Selected "L2 cache miss ratio"

Criando nova métrica no Cube

`Instructions per cycle / BT-MZ.S`

Criando nova métrica no Cube

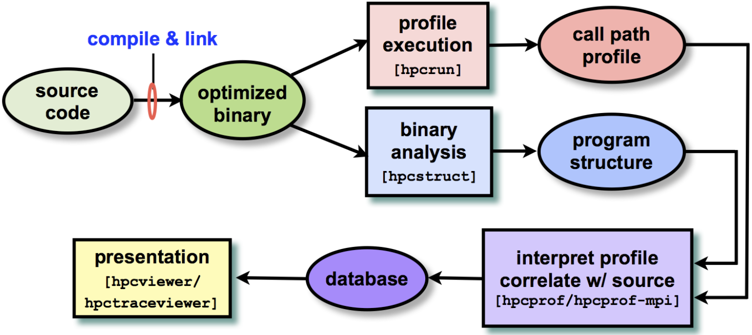
`Instructions per cycle / BT-MZ.W`

Roteiro

1. Scalasca, Score-p, Cube
2. hpctoolkit

HPCToolkit

`http://hpctoolkit.org`



compile & link

source code

optimized binary

profile execution [hpcrun]

call path profile

binary analysis [hpcstruct]

program structure

interpret profile correlate w/ source [hpcprof/hpcprof-mpi]

database

presentation [hpcviewer/ hpctraceviewer]

HPCToolkit

Exemplo: NAS Parallel Benchmarks (NPB)

```
hpctoolkit/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_hpctoolkit
       README
```

HPCToolkit

Exemplo: NAS Parallel Benchmarks (NPB)

```
hpctoolkit/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_hpctoolkit
       README
```

HPCToolkit

Preparando o ambiente

```
$ cat env_hpctoolkit

module load openmpi/gnu/2.0.4.2
module load hpctoolkit/5.3.2_4712
module load papi/5.5.1.0
module load papi-devel/5.5.1.0
```

HPCToolkit

```
hpctoolkit/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_hpctoolkit
       README
```

HPCToolkit

```
hpctoolkit/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
          bin/
          BT-MZ/
          common/
          config/
          LU-MZ/
          SP-MZ/
          sys/
          Makefile
          README
          README.install
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_hpctoolkit
       README
```

HPCToolkit

```
hpctoolkit/
    NPB3.3.1-MZ/
       NPB3.3-MZ-MPI/
          bin/
          BT-MZ/
          common/
          config/
          LU-MZ/
          SP-MZ/
          sys/
          Makefile
          README
          README.install
       NPB3.3-MZ-OMP/
       NPB3.3-MZ-SER/
       Changes.log
       env_hpctoolkit
       README
```

HPCToolkit

```
config/
   NAS.samples
   make.def -> make_hpctoolkit.def
   make.def.template
   make_hpctoolkit.def
   suite.def
   suite.def.template
```

HPCToolkit

```
config/
   NAS.samples
   make.def -> make_hpctoolkit.def
   make.def.template
   make_hpctoolkit.def
   suite.def
   suite.def.template
```

HPCToolkit

```
$ cat make_hpctoolkit.def

#---------------------------------------------------------------------------
# This is the fortran compiler used for fortran programs
#---------------------------------------------------------------------------
F77 = mpif77
#F77 = scalasca -instrument mpif77
#F77 = scorep mpif77


#---------------------------------------------------------------------------
# This is the C compiler used for C programs
#---------------------------------------------------------------------------
CC = mpicc
#CC = scalasca -instrument mpicc
#CC = scorep mpicc
```

HPCToolkit

NPB: benchmark, classe e número de processos MPI

```
config/
   NAS.samples
   make.def -> make_hpctoolkit.def
   make.def.template
   make_hpctoolkit.def
   suite.def
   suite.def.template
```

HPCToolkit

NPB: benchmark, classe e número de processos MPI

```
config/
   NAS.samples
   make.def -> make_hpctoolkit.def
   make.def.template
   make_hpctoolkit.def
   suite.def
   suite.def.template
```

Estudo de caso

NPB: benchmark, classe e número de processos MPI

```
$ cat suite.def

# config/suite.def
# This file is used to build several benchmarks with a single command.
# Typing "make suite" in the main directory will build all the benchmarks
# specified in this file.
# Each line of this file contains a benchmark name, class, and number
# of nodes. The name is one of "sp-mz", "bt-mz", and "lu-mz".
# The class is one of "S", "W", and "A" through "F".
# No blank lines.
# The following example builds serial sample sizes of all benchmarks.
#sp-mz S 1
#lu-mz S 1
#bt-mz S 2
bt-mz   S       1
bt-mz   S       2
bt-mz   S       4
bt-mz   W       1
bt-mz   W       2
bt-mz   W       4
bt-mz   W       8
bt-mz   W       16
```

Estudo de caso

NPB: compilação

```
$ cd ..
$ make suite %compila o NPB
$ cd bin
```

Estudo de caso

NPB: compilação

```
$ ls -A1
bt-mz.S.1
bt-mz.S.2
bt-mz.S.4
bt-mz.W.1
bt-mz.W.2
bt-mz.W.4
bt-mz.W.8
bt-mz.W.16
BULL_srun_hpctoolkit.sh
```

HPCToolkit

`BULL_srun_hpctoolkit.sh`

Estudo de caso

NPB: submetendo job

```
$ sbatch BULL_srun_hpctoolkit.sh bt-mz W
Submitted batch job 438988
$ squeue -u $USER
JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
438988 treinamen NPB_BT-M professo  R       0:02      1 sdumont3000
```

Estudo de caso

NPB: perfil de desempenho

```
$ ls -A1
bt-mz.S.1
bt-mz.S.2
bt-mz.S.4
bt-mz.W.1
bt-mz.W.2
bt-mz.W.4
bt-mz.W.8
bt-mz.W.16
BULL_srun_hpctoolkit.sh
hpctoolkit/
```

Estudo de caso

NPB: perfil de desempenho

```
hpctoolkit/
 NUMNODES-1
     bt-mz_W_MPI-1_OMP-1_JOBID-438988
        bt-mz.W.1.hpcstruct
        hpctoolkit-bt-mz.W.1-database-438988
        hpctoolkit-bt-mz.W.1-measurements-438988
        slurm-438988.out
```

Estudo de caso

NPB: perfil de desempenho

```
hpctoolkit/
 NUMNODES-1
     bt-mz_W_MPI-1_OMP-1_JOBID-438988
        bt-mz.W.1.hpcstruct
        hpctoolkit-bt-mz.W.1-database-438988
        hpctoolkit-bt-mz.W.1-measurements-438988
        slurm-438988.out
```

Estudo de caso

NPB: perfil de desempenho

```
hpctoolkit/
 NUMNODES-1
     bt-mz_W_MPI-1_OMP-1_JOBID-438988
        bt-mz.W.1.hpcstruct
        hpctoolkit-bt-mz.W.1-database-438988
        hpctoolkit-bt-mz.W.1-measurements-438988
        slurm-438988.out
```

Estudo de caso

```
$ cat slurm-438988.out

Cluster configuration:
===
Partition:  treinamento
Number of nodes:  1
Number of MPI processes:  1  ( 1  nodes)
Number of MPI processes per node:
Number of threads per MPI process:  1
NPB Benchmark:  bt-mz
Bechmark class problem:  W
[1580508594.340437] [sdumont5000:81015:0]         mxm.c:196  MXM  WARN  The 'ulimit -s' on the sys
[1580508594.342077] [sdumont5000:81015:0]         mxm.c:196  MXM  WARN  The 'ulimit -s' on the sys


 NAS Parallel Benchmarks (NPB3.3-MZ-MPI) - BT-MZ MPI+OpenMP Benchmark

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     1

 Use the default load factors with threads
 Total number of threads:     1  (  1.0 threads/process)

 Calculated speedup =      1.00

 Time step    1
 Time step   20
```

Estudo de caso (cont.)

```
Time step   40
Time step   60
Time step   80
Time step  100
Time step  120
Time step  140
Time step  160
Time step  180
Time step  200
Verification being performed for class W
accuracy setting for epsilon =  0.1000000000000E-07
Comparison of RMS-norms of residual
          1 0.5562611195402E+05 0.5562611195402E+05 0.2289019558898E-13
          2 0.5151404119932E+04 0.5151404119932E+04 0.3195605260010E-13
          3 0.1080453907954E+05 0.1080453907954E+05 0.4314917838667E-12
          4 0.6576058591929E+04 0.6576058591929E+04 0.2033067669511E-13
          5 0.4528609293561E+05 0.4528609293561E+05 0.3100863263992E-13
Comparison of RMS-norms of solution error
          1 0.7185154786403E+04 0.7185154786403E+04 0.4961924046085E-13
          2 0.7040472738068E+03 0.7040472738068E+03 0.3326408529931E-13
          3 0.1437035074443E+04 0.1437035074443E+04 0.1887614294376E-12
          4 0.8570666307849E+03 0.8570666307849E+03 0.3143720636440E-13
          5 0.5991235147368E+04 0.5991235147368E+04 0.6770467641700E-13
Verification Successful


BT-MZ Benchmark Completed.
Class           =                        W
Size            =             64x   64x  8
Iterations      =                      200
```

Estudo de caso (cont.)

```
 Time in seconds =                     5.58
 Total processes =                        1
 Total threads   =                        1
 Mop/s total     =                  2572.99
 Mop/s/thread    =                  2572.99
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1
 Compile date    =              31 Jan 2020

 Compile options:
    F77          = mpif77
    FLINK        = $(F77)
    F_LIB        = (none)
    FFLAGS       = -O3 -fopenmp -g
    FLINKFLAGS   = $(FFLAGS)
    RAND         = (none)


 Please send all errors/feedbacks to:

 NPB Development Team
 npb@nas.nasa.gov


msg: STRUCTURE: /scratch/treinamento/professor/modulo1/MC1-I/tools/hpctoolkit/NPB3.3.1-MZ/NPB3.3-M
msg: Line map : /opt/bullxde/profilers/hpctoolkit/5.3.2_4712/lib/hpctoolkit/ext-libs/libmonitor.so
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/libmpi_mpifh.so.20.2.1
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/libmpi.so.20.0.4
msg: Line map : /usr/lib64/libgomp.so.1.0.0
```

Estudo de caso (cont.)

```
msg: Line map : /usr/lib64/libc-2.17.so
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/libopen-rte.so.20.1.2
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/libopen-pal.so.20.2.2
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_ess_pmi.so
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_pml_cm.so
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_pml_yalla.so
msg: Line map : /opt/mellanox/mxm/lib/libmxm.so.2.0.32
msg: Line map : /opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_mtl_mxm.so
msg: Populating Experiment database: /scratch/treinamento/professor/modulo1/MC1-I/tools/hpctoolkit
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=1 BULL_srun_hpctoolkit.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     1

 Use the default load factors with threads
 Total number of threads:      1  (  1.0 threads/process)

 Calculated speedup =      1.00

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =            64x   64x   8
 Iterations      =                      200
 Time in seconds =                     5.58
 Total processes =                        1
 Total threads   =                        1
 Mop/s total     =                  2572.99
 Mop/s/thread    =                  2572.99
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=2 BULL_srun_hpctoolkit.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     2

 Use the default load factors with threads
 Total number of threads:      2  (  1.0 threads/process)

 Calculated speedup =      1.98

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x   64x  8
 Iterations      =                      200
 Time in seconds =                     2.84
 Total processes =                        2
 Total threads   =                        2
 Mop/s total     =                  5056.23
 Mop/s/thread    =                  2528.12
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=4 BULL_srun_hpctoolkit.sh bt-mz W

 Number of zones:    4 x    4
 Iterations: 200     dt:    0.000800
 Number of active processes:     4

 Use the default load factors with threads
 Total number of threads:      4   (  1.0 threads/process)

 Calculated speedup =      3.95

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x    64x   8
 Iterations      =                      200
 Time in seconds =                     1.49
 Total processes =                        4
 Total threads   =                        4
 Mop/s total     =                  9610.43
 Mop/s/thread    =                  2402.61
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=8 BULL_srun_hpctoolkit.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:     8

 Use the default load factors with threads
 Total number of threads:      8  (  1.0 threads/process)

 Calculated speedup =      4.87

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x   64x  8
 Iterations      =                      200
 Time in seconds =                     1.29
 Total processes =                        8
 Total threads   =                        8
 Mop/s total     =                 11125.59
 Mop/s/thread    =                  1390.70
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1
```

Estudo de caso

```
sbatch --nodes=1 --ntasks=16 BULL_srun_hpctoolkit.sh bt-mz W

 Number of zones:   4 x   4
 Iterations: 200    dt:   0.000800
 Number of active processes:    16

 Use the default load factors with threads
 Total number of threads:     16  (  1.0 threads/process)

 Calculated speedup =      4.87

 BT-MZ Benchmark Completed.
 Class           =                        W
 Size            =             64x   64x  8
 Iterations      =                      200
 Time in seconds =                     1.28
 Total processes =                       16
 Total threads   =                       16
 Mop/s total     =                 11181.49
 Mop/s/thread    =                   698.84
 Operation type  =           floating point
 Verification    =               SUCCESSFUL
 Version         =                    3.3.1
```

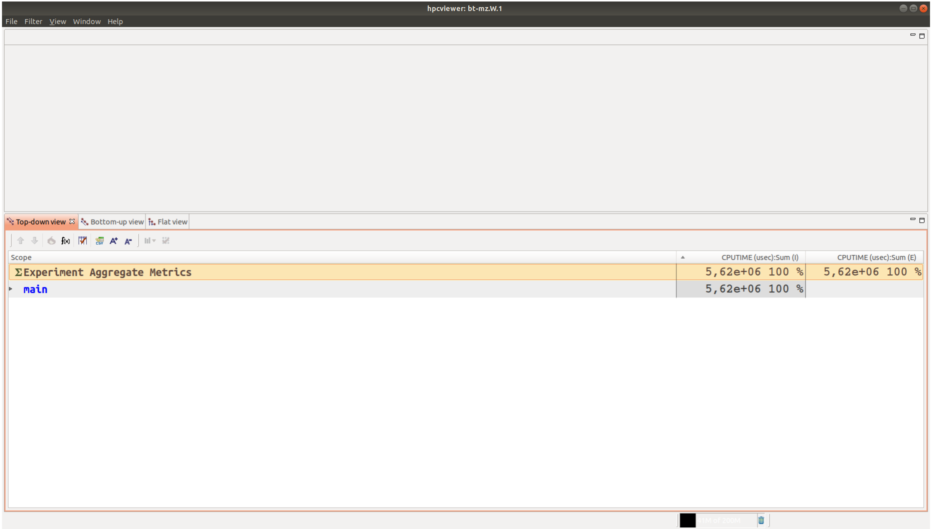
Visualizando no **`hpcviewer`**

NPB: estudo de caso

```
$ cd profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-1_OMP-1_JOBID-438988
$ hpcviewer hpctoolkit-bt-mz.W.1-database-438988/
```

Visualizando no **hpcviewer**

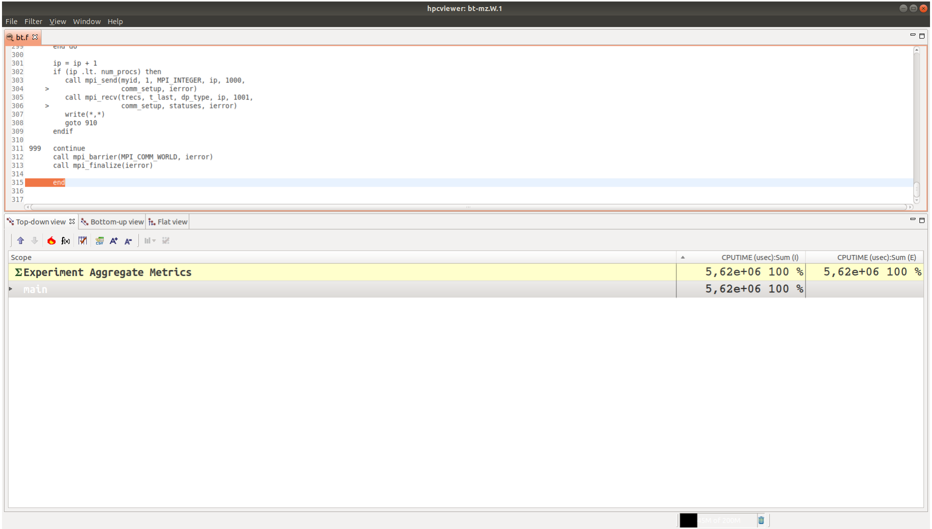
`-nodes=1 -ntasks=1 / Top-down view`



Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
main	5,62e+06 100 %	

Visualizando no **`hpcviewer`**

`-nodes=1 -ntasks=1 / Top-down view`

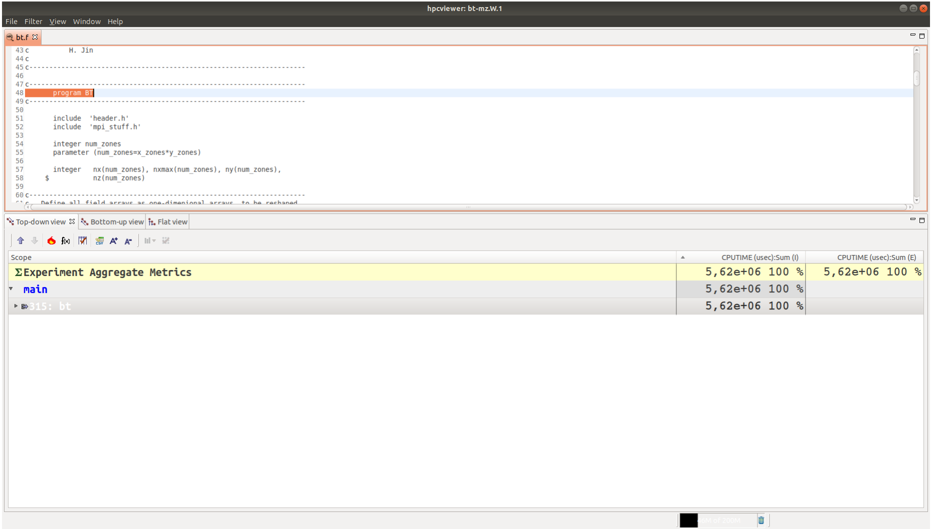


```
      end do

      ip = ip + 1
      if (ip .lt. num_procs) then
         call mpi_send(myid, 1, MPI_INTEGER, ip, 1000,
     >                 comm_setup, ierror)
         call mpi_recv(trecs, t_last, dp_type, ip, 1001,
     >                 comm_setup, statuses, ierror)
         write(*,*)
         goto 910
      endif

 999  continue
      call mpi_barrier(MPI_COMM_WORLD, ierror)
      call mpi_finalize(ierror)

      end
```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
main	5,62e+06 100 %	

Visualizando no **`hpcviewer`**

`-nodes=1 -ntasks=1 / Top-down view`

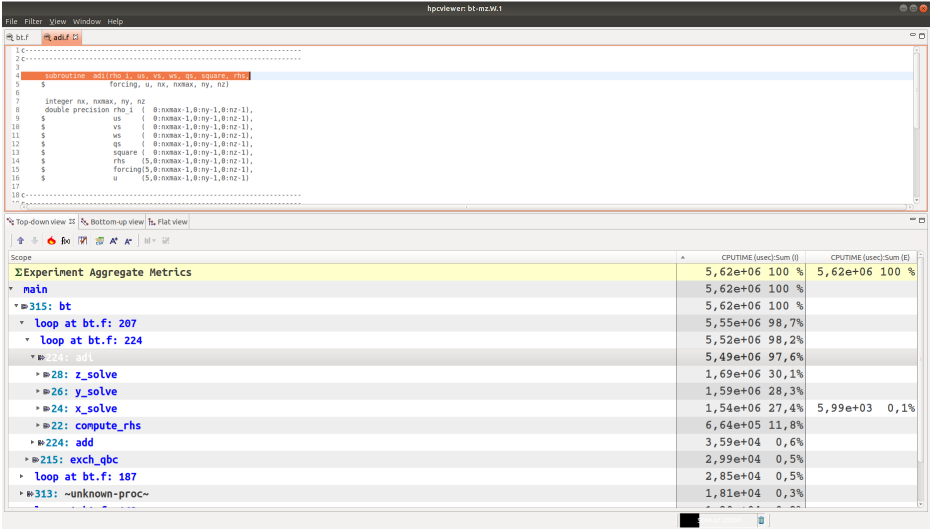


```
c          H. Jin
c
c---------------------------------------------------------------------

c---------------------------------------------------------------------
      program BT
c---------------------------------------------------------------------

      include  'header.h'
      include  'mpi_stuff.h'

      integer num_zones
      parameter (num_zones=x_zones*y_zones)

      integer   nx(num_zones), nxmax(num_zones), ny(num_zones),
     $          nz(num_zones)

c---------------------------------------------------------------------
c   Define all field arrays as one-dimenional arrays, to be reshaped
```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
main	5,62e+06 100 %	
315: bt	5,62e+06 100 %	

Visualizando no **hpcviewer**

`-nodes=1 -ntasks=1 / Top-down view`

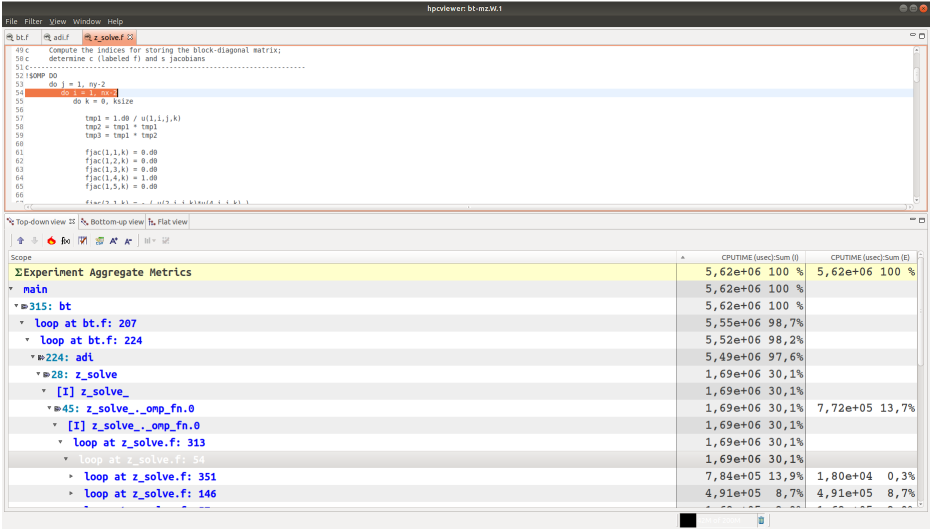


```
c---------------------------------------------------------------------
c---------------------------------------------------------------------

      subroutine  adi(rho_i, us, vs, ws, qs, square, rhs,
     $                forcing, u, nx, nxmax, ny, nz)

      integer nx, nxmax, ny, nz
      double precision rho_i  (  0:nxmax-1,0:ny-1,0:nz-1),
     $                 us     (  0:nxmax-1,0:ny-1,0:nz-1),
     $                 vs     (  0:nxmax-1,0:ny-1,0:nz-1),
     $                 ws     (  0:nxmax-1,0:ny-1,0:nz-1),
     $                 qs     (  0:nxmax-1,0:ny-1,0:nz-1),
     $                 square (  0:nxmax-1,0:ny-1,0:nz-1),
     $                 rhs    (5,0:nxmax-1,0:ny-1,0:nz-1),
     $                 forcing(5,0:nxmax-1,0:ny-1,0:nz-1),
     $                 u      (5,0:nxmax-1,0:ny-1,0:nz-1)

c---------------------------------------------------------------------
```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
main	5,62e+06 100 %	
315: bt	5,62e+06 100 %	
loop at bt.f: 207	5,55e+06 98,7%	
loop at bt.f: 224	5,52e+06 98,2%	
224: adi	5,49e+06 97,6%	
28: z_solve	1,69e+06 30,1%	
26: y_solve	1,59e+06 28,3%	
24: x_solve	1,54e+06 27,4%	5,99e+03 0,1%
22: compute_rhs	6,64e+05 11,8%	
224: add	3,59e+04 0,6%	
215: exch_qbc	2,99e+04 0,5%	
loop at bt.f: 187	2,85e+04 0,5%	
313: ~unknown-proc~	1,81e+04 0,3%	

Visualizando no **hpcviewer**

-nodes=1 -ntasks=1 / Top-down view

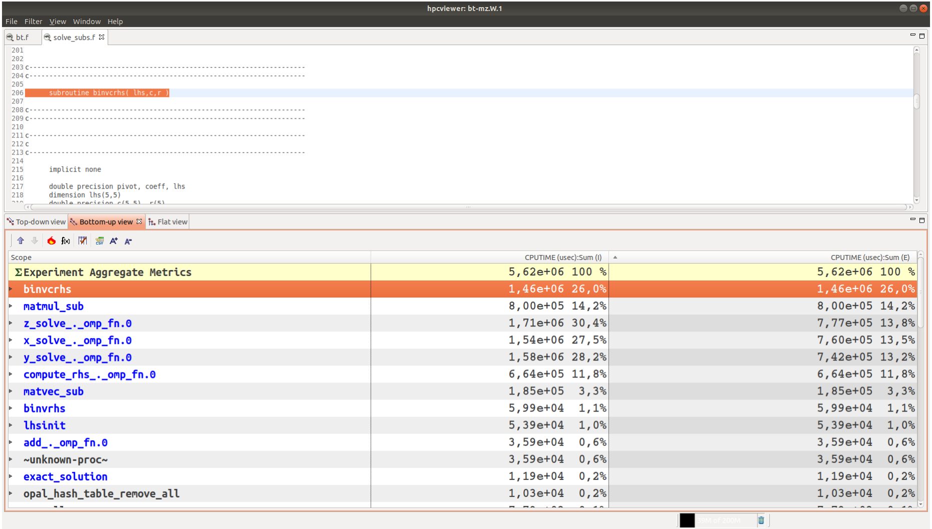


```
c     Compute the indices for storing the block-diagonal matrix;
c     determine c (labeled f) and s jacobians
c-------------------------------------------------------------------
!$OMP DO
      do j = 1, ny-2
         do i = 1, nx-2
            do k = 0, ksize

               tmp1 = 1.d0 / u(1,i,j,k)
               tmp2 = tmp1 * tmp1
               tmp3 = tmp1 * tmp2

               fjac(1,1,k) = 0.d0
               fjac(1,2,k) = 0.d0
               fjac(1,3,k) = 0.d0
               fjac(1,4,k) = 1.d0
               fjac(1,5,k) = 0.d0

```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
main	5,62e+06 100 %	
315: bt	5,62e+06 100 %	
loop at bt.f: 207	5,55e+06 98,7%	
loop at bt.f: 224	5,52e+06 98,2%	
224: adi	5,49e+06 97,6%	
28: z_solve	1,69e+06 30,1%	
[I] z_solve_	1,69e+06 30,1%	
45: z_solve_._omp_fn.0	1,69e+06 30,1%	7,72e+05 13,7%
[I] z_solve_._omp_fn.0	1,69e+06 30,1%	
loop at z_solve.f: 313	1,69e+06 30,1%	
loop at z_solve.f: 54	1,69e+06 30,1%	
loop at z_solve.f: 351	7,84e+05 13,9%	1,80e+04 0,3%
loop at z_solve.f: 146	4,91e+05 8,7%	4,91e+05 8,7%

Visualizando no **hpcviewer**

`-nodes=1 -ntasks=1 / Bottom-up view`

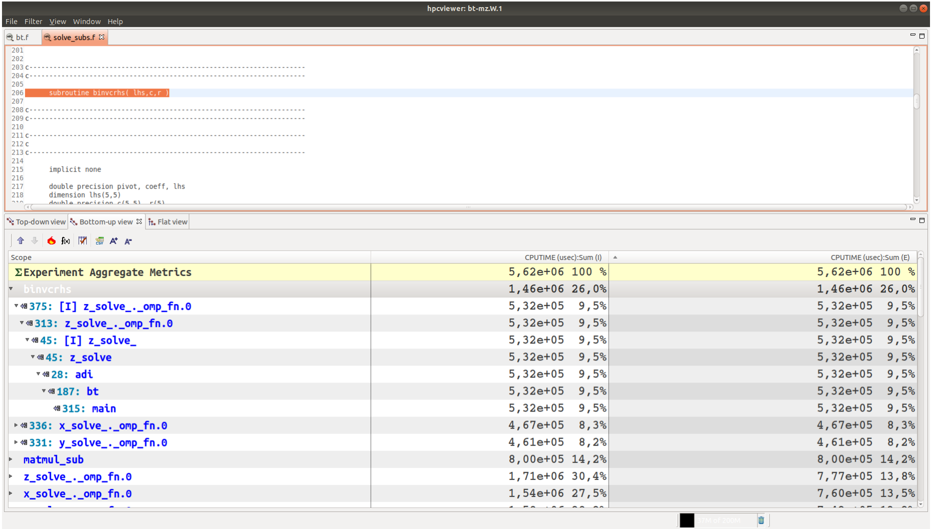


```
c---------------------------------------------------------------------
c---------------------------------------------------------------------

      subroutine binvcrhs( lhs,c,r )

c---------------------------------------------------------------------
c---------------------------------------------------------------------

c---------------------------------------------------------------------
c
c---------------------------------------------------------------------

      implicit none

      double precision pivot, coeff, lhs
      dimension lhs(5,5)
```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
Σ Experiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
binvcrhs	1,46e+06 26,0%	1,46e+06 26,0%
matmul_sub	8,00e+05 14,2%	8,00e+05 14,2%
z_solve_._omp_fn.0	1,71e+06 30,4%	7,77e+05 13,8%
x_solve_._omp_fn.0	1,54e+06 27,5%	7,60e+05 13,5%
y_solve_._omp_fn.0	1,58e+06 28,2%	7,42e+05 13,2%
compute_rhs_._omp_fn.0	6,64e+05 11,8%	6,64e+05 11,8%
matvec_sub	1,85e+05 3,3%	1,85e+05 3,3%
binvrhs	5,99e+04 1,1%	5,99e+04 1,1%
lhsinit	5,39e+04 1,0%	5,39e+04 1,0%
add_._omp_fn.0	3,59e+04 0,6%	3,59e+04 0,6%
~unknown-proc~	3,59e+04 0,6%	3,59e+04 0,6%
exact_solution	1,19e+04 0,2%	1,19e+04 0,2%
opal_hash_table_remove_all	1,03e+04 0,2%	1,03e+04 0,2%

Visualizando no **hpcviewer**

-nodes=1 -ntasks=1 / Bottom-up view

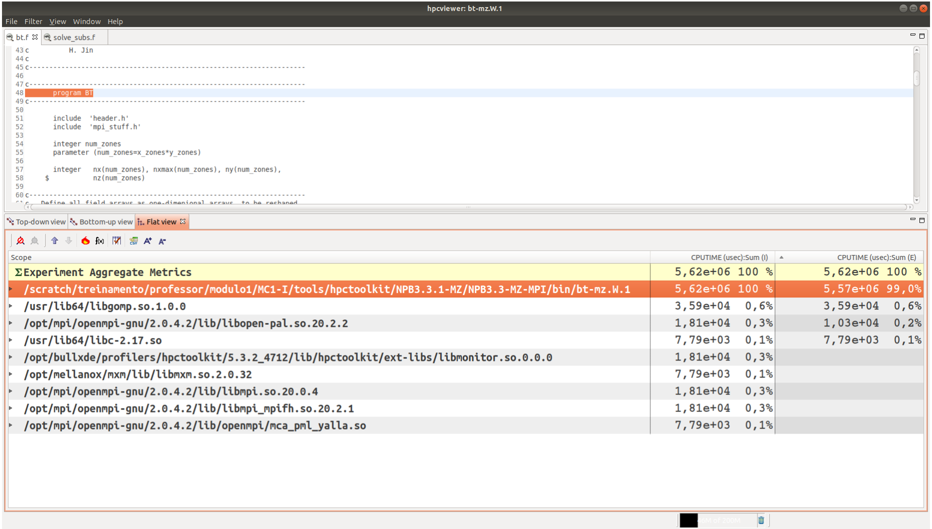


```
c--------------------------------------------------------------------
c--------------------------------------------------------------------

      subroutine binvcrhs( lhs,c,r )

c--------------------------------------------------------------------
c--------------------------------------------------------------------

c--------------------------------------------------------------------
c
c--------------------------------------------------------------------

      implicit none

      double precision pivot, coeff, lhs
      dimension lhs(5,5)
      double precision c(5,5), r(5)
```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
binvcrhs	1,46e+06 26,0%	1,46e+06 26,0%
375: [I] z_solve_._omp_fn.0	5,32e+05 9,5%	5,32e+05 9,5%
313: z_solve_._omp_fn.0	5,32e+05 9,5%	5,32e+05 9,5%
45: [I] z_solve_	5,32e+05 9,5%	5,32e+05 9,5%
45: z_solve	5,32e+05 9,5%	5,32e+05 9,5%
28: adi	5,32e+05 9,5%	5,32e+05 9,5%
187: bt	5,32e+05 9,5%	5,32e+05 9,5%
315: main	5,32e+05 9,5%	5,32e+05 9,5%
336: x_solve_._omp_fn.0	4,67e+05 8,3%	4,67e+05 8,3%
331: y_solve_._omp_fn.0	4,61e+05 8,2%	4,61e+05 8,2%
matmul_sub	8,00e+05 14,2%	8,00e+05 14,2%
z_solve_._omp_fn.0	1,71e+06 30,4%	7,77e+05 13,8%
x_solve_._omp_fn.0	1,54e+06 27,5%	7,60e+05 13,5%

Visualizando no **`hpcviewer`**

`-nodes=1 -ntasks=1 / Flat view`

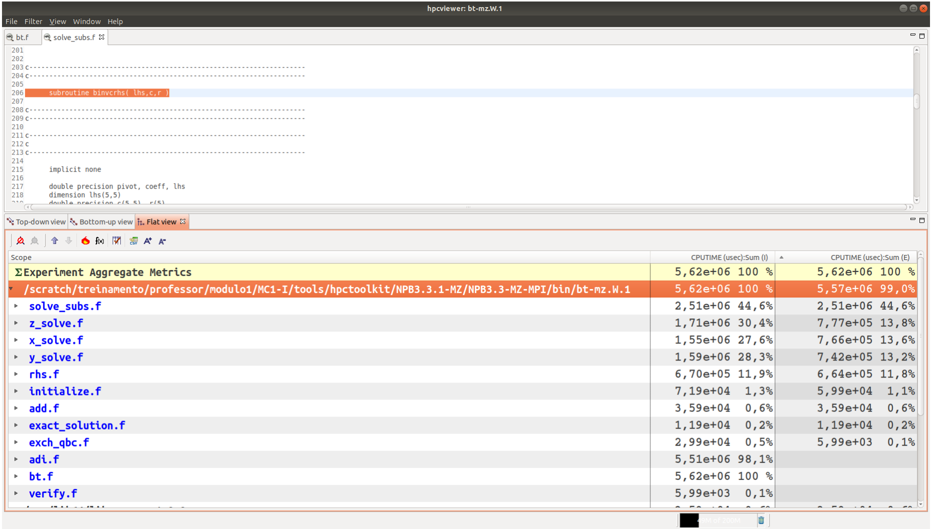


```
c          H. Jin
c
c---------------------------------------------------------------------
 
c---------------------------------------------------------------------
       program BT
c---------------------------------------------------------------------

       include  'header.h'
       include  'mpi_stuff.h'

       integer num_zones
       parameter (num_zones=x_zones*y_zones)

       integer   nx(num_zones), nxmax(num_zones), ny(num_zones),
     $           nz(num_zones)

c---------------------------------------------------------------------
c   Define all field arrays as one-dimensional arrays, to be reshaped
```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
/scratch/treinamento/professor/modulo1/MC1-I/tools/hpctoolkit/NPB3.3.1-MZ/NPB3.3-MZ-MPI/bin/bt-mz.W.1	5,62e+06 100 %	5,57e+06 99,0%
/usr/lib64/libgomp.so.1.0.0	3,59e+04 0,6%	3,59e+04 0,6%
/opt/mpi/openmpi-gnu/2.0.4.2/lib/libopen-pal.so.20.2.2	1,81e+04 0,3%	1,03e+04 0,2%
/usr/lib64/libc-2.17.so	7,79e+03 0,1%	7,79e+03 0,1%
/opt/bullxde/profilers/hpctoolkit/5.3.2_4712/lib/hpctoolkit/ext-libs/libmonitor.so.0.0.0	1,81e+04 0,3%	
/opt/mellanox/mxm/lib/libmxm.so.2.0.32	7,79e+03 0,1%	
/opt/mpi/openmpi-gnu/2.0.4.2/lib/libmpi.so.20.0.4	1,81e+04 0,3%	
/opt/mpi/openmpi-gnu/2.0.4.2/lib/libmpi_mpifh.so.20.2.1	1,81e+04 0,3%	
/opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_pml_yalla.so	7,79e+03 0,1%	

Visualizando no **hpcviewer**

-nodes=1 -ntasks=1 / Flat view



```
c---------------------------------------------------------------------
c---------------------------------------------------------------------

      subroutine binvcrhs( lhs,c,r )

c---------------------------------------------------------------------
c---------------------------------------------------------------------

c---------------------------------------------------------------------
c
c---------------------------------------------------------------------

      implicit none

      double precision pivot, coeff, lhs
      dimension lhs(5,5)
```

Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
ΣExperiment Aggregate Metrics	5,62e+06 100 %	5,62e+06 100 %
/scratch/treinamento/professor/modulo1/MC1-I/tools/hpctoolkit/NPB3.3.1-MZ/NPB3.3-MZ-MPI/bin/bt-mz.W.1	5,62e+06 100 %	5,57e+06 99,0%
solve_subs.f	2,51e+06 44,6%	2,51e+06 44,6%
z_solve.f	1,71e+06 30,4%	7,77e+05 13,8%
x_solve.f	1,55e+06 27,6%	7,66e+05 13,6%
y_solve.f	1,59e+06 28,3%	7,42e+05 13,2%
rhs.f	6,70e+05 11,9%	6,64e+05 11,8%
initialize.f	7,19e+04 1,3%	5,99e+04 1,1%
add.f	3,59e+04 0,6%	3,59e+04 0,6%
exact_solution.f	1,19e+04 0,2%	1,19e+04 0,2%
exch_qbc.f	2,99e+04 0,5%	5,99e+03 0,1%
adi.f	5,51e+06 98,1%	
bt.f	5,62e+06 100 %	
verify.f	5,99e+03 0,1%	

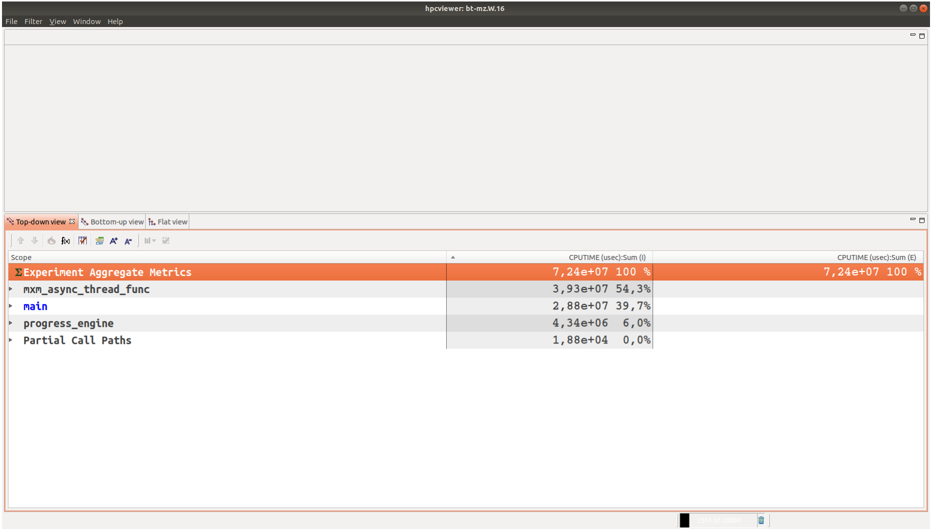
Visualizando no `hpcviewer`

NPB: estudo de caso

```
$ cd profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032
$ hpcviewer hpctoolkit-bt-mz.W.16-database-439032
```

Visualizando no `hpcviewer`

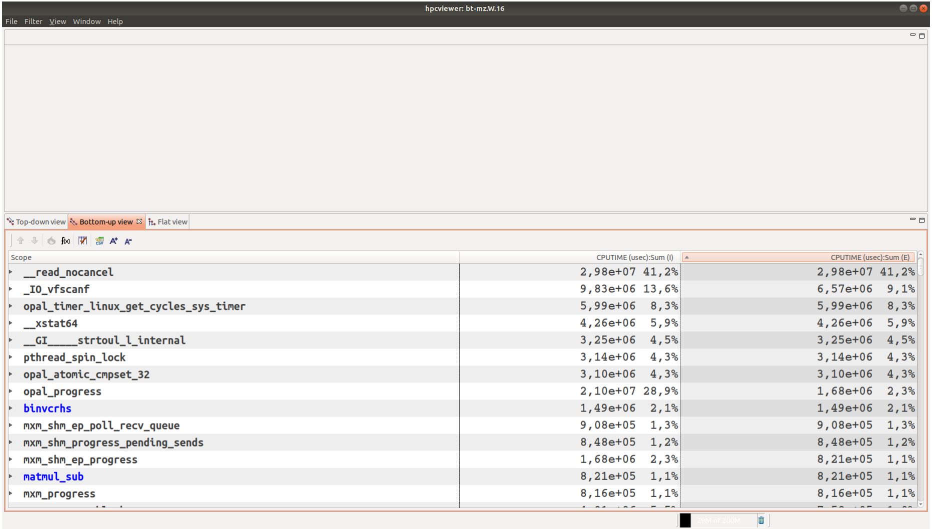
`-nodes=1 -ntasks=16 / Top-down view`



Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
Σ Experiment Aggregate Metrics	7,24e+07 100 %	7,24e+07 100 %
mxm_async_thread_func	3,93e+07 54,3%	
main	2,88e+07 39,7%	
progress_engine	4,34e+06 6,0%	
Partial Call Paths	1,88e+04 0,0%	

Visualizando no **hpcviewer**

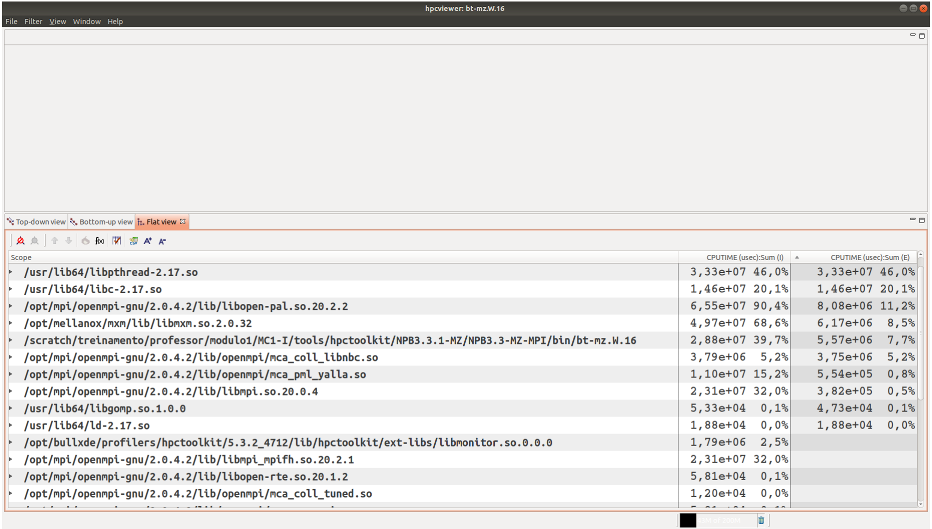
-nodes=1 -ntasks=16 / Bottom-up view



Scope	CPUTIME (usec):Sum (I)		CPUTIME (usec):Sum (E)	
__read_nocancel	2,98e+07	41,2%	2,98e+07	41,2%
_IO_vfscanf	9,83e+06	13,6%	6,57e+06	9,1%
opal_timer_linux_get_cycles_sys_timer	5,99e+06	8,3%	5,99e+06	8,3%
__xstat64	4,26e+06	5,9%	4,26e+06	5,9%
__GI_____strtoul_l_internal	3,25e+06	4,5%	3,25e+06	4,5%
pthread_spin_lock	3,14e+06	4,3%	3,14e+06	4,3%
opal_atomic_cmpset_32	3,10e+06	4,3%	3,10e+06	4,3%
opal_progress	2,10e+07	28,9%	1,68e+06	2,3%
binvcrhs	1,49e+06	2,1%	1,49e+06	2,1%
mxm_shm_ep_poll_recv_queue	9,08e+05	1,3%	9,08e+05	1,3%
mxm_shm_progress_pending_sends	8,48e+05	1,2%	8,48e+05	1,2%
mxm_shm_ep_progress	1,68e+06	2,3%	8,21e+05	1,1%
matmul_sub	8,21e+05	1,1%	8,21e+05	1,1%
mxm_progress	8,16e+05	1,1%	8,16e+05	1,1%

Visualizando no **hpcviewer**

`-nodes=1 -ntasks=16 / Flat view`



Scope	CPUTIME (usec):Sum (I)	CPUTIME (usec):Sum (E)
/usr/lib64/libpthread-2.17.so	3,33e+07 46,0%	3,33e+07 46,0%
/usr/lib64/libc-2.17.so	1,46e+07 20,1%	1,46e+07 20,1%
/opt/mpi/openmpi-gnu/2.0.4.2/lib/libopen-pal.so.20.2.2	6,55e+07 90,4%	8,08e+06 11,2%
/opt/mellanox/mxm/lib/libmxm.so.2.0.32	4,97e+07 68,6%	6,17e+06 8,5%
/scratch/treinamento/professor/modulo1/MC1-I/tools/hpctoolkit/NPB3.3.1-MZ/NPB3.3-MZ-MPI/bin/bt-mz.W.16	2,88e+07 39,7%	5,57e+06 7,7%
/opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_coll_libnbc.so	3,79e+06 5,2%	3,75e+06 5,2%
/opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_pml_yalla.so	1,10e+07 15,2%	5,54e+05 0,8%
/opt/mpi/openmpi-gnu/2.0.4.2/lib/libmpi.so.20.0.4	2,31e+07 32,0%	3,82e+05 0,5%
/usr/lib64/libgomp.so.1.0.0	5,33e+04 0,1%	4,73e+04 0,1%
/usr/lib64/ld-2.17.so	1,88e+04 0,0%	1,88e+04 0,0%
/opt/bullxde/profilers/hpctoolkit/5.3.2_4712/lib/hpctoolkit/ext-libs/libmonitor.so.0.0.0	1,79e+06 2,5%	
/opt/mpi/openmpi-gnu/2.0.4.2/lib/libmpi_mpifh.so.20.2.1	2,31e+07 32,0%	
/opt/mpi/openmpi-gnu/2.0.4.2/lib/libopen-rte.so.20.1.2	5,81e+04 0,1%	
/opt/mpi/openmpi-gnu/2.0.4.2/lib/openmpi/mca_coll_tuned.so	1,20e+04 0,0%	

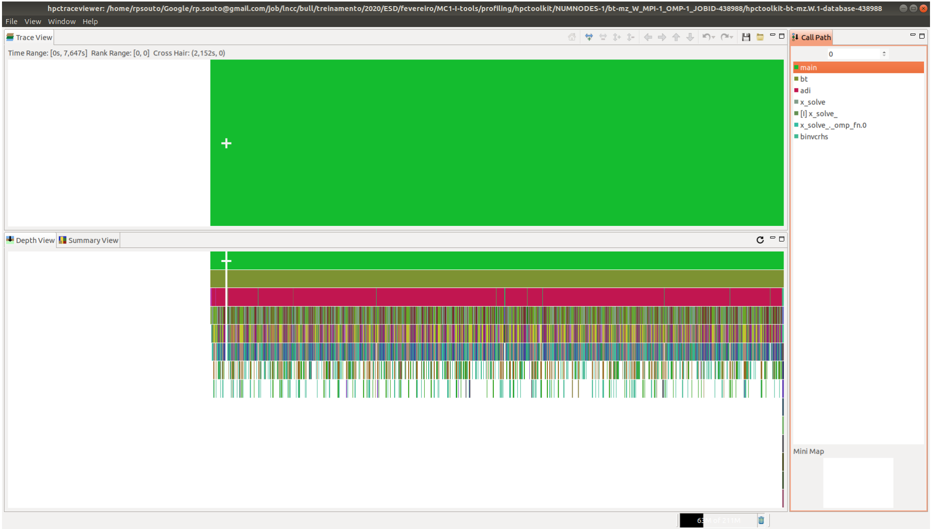
Visualizando no `hpctraceview`

NPB: estudo de caso

```
$ cd profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-1_OMP-1_JOBID-438988
$ hpctraceview hpctoolkit-bt-mz.W.1-database-438988/
```

Visualizando no `hpctraceview`

`-nodes=1 -ntasks=1`


hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-1_OMP-1_JOBID-438988/hpctoolkit-bt-mz.W.1-database-438988
File
View
Window
Help
Trace View
Call Path
0
main
bt
adi
x_solve
[I] x_solve_
x_solve_._omp_fn.0
binvcrhs
Depth View
Summary View
Mini Map

Time Range: [0s, 7,647s] Rank Range: [0, 0] Cross Hair: (2,152s, 0)

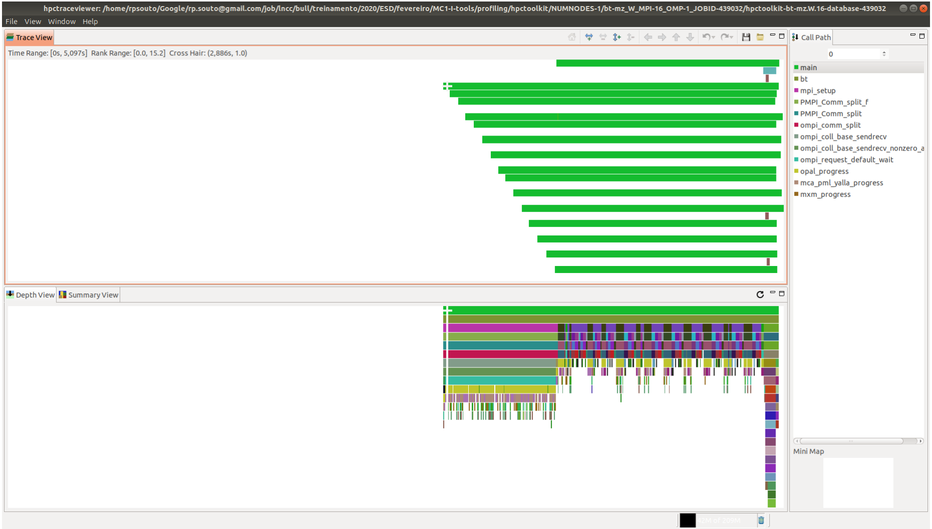
Visualizando no **`hpctraceview`**

NPB: estudo de caso

```
$ cd profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032
$ hpctraceview hpctoolkit-bt-mz.W.16-database-439032
```

Visualizando no `hpctraceview`

`-nodes=1 -ntasks=16`



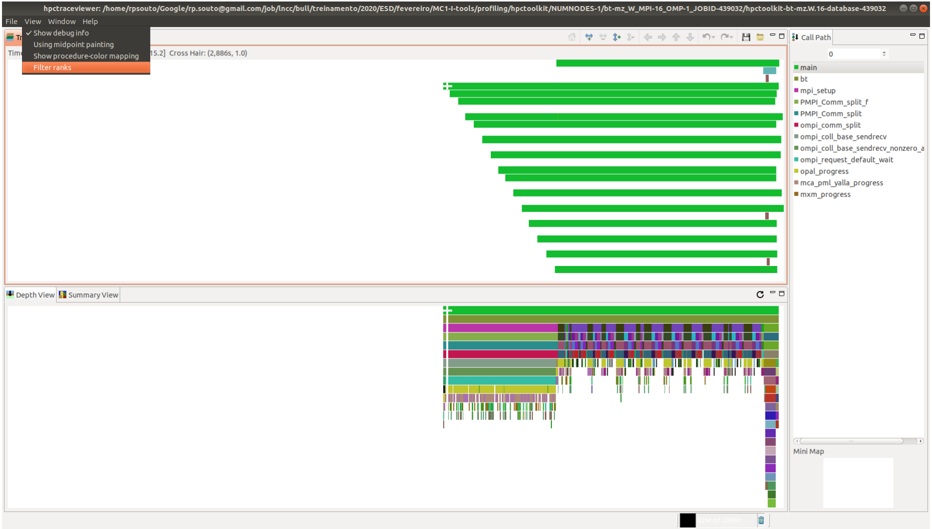
hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Time Range: [0s, 5,097s] Rank Range: [0.0, 15.2] Cross Hair: (2,886s, 1.0)

- 🟩 main
- 🟩 bt
- 🟪 mpi_setup
- 🟩 PMPI_Comm_split_f
- 🟦 PMPI_Comm_split
- 🟥 ompi_comm_split
- ▨ ompi_coll_base_sendrecv
- 🟩 ompi_coll_base_sendrecv_nonzero_a
- 🟦 ompi_request_default_wait
- 🟨 opal_progress
- 🟫 mca_pml_yalla_progress
- 🟫 mxm_progress

Visualizando no `hpctraceview`

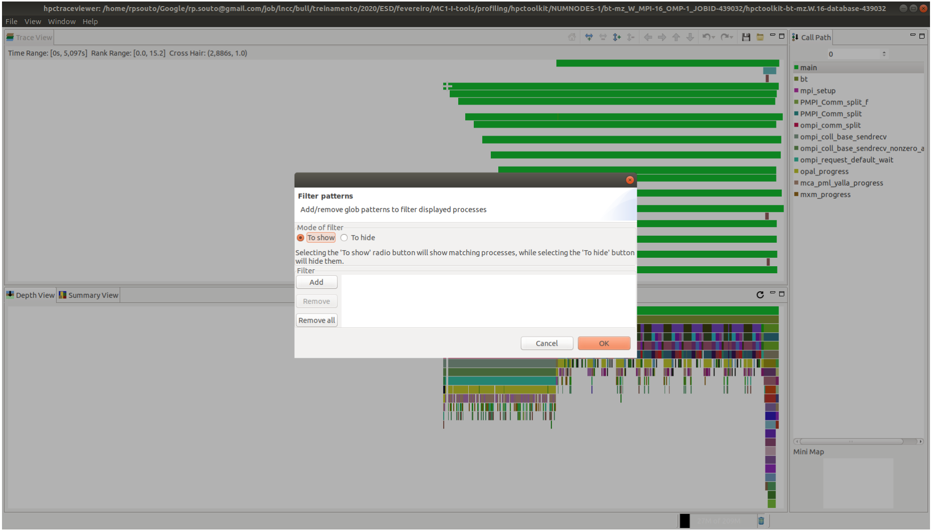
`-nodes=1 -ntasks=16`



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Visualizando no `hpctraceview`

`–nodes=1 –ntasks=16`



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Time Range: [0s, 5,097s] Rank Range: [0.0, 15.2] Cross Hair: (2,886s, 1.0)

Filter patterns

Add/remove glob patterns to filter displayed processes

Mode of filter

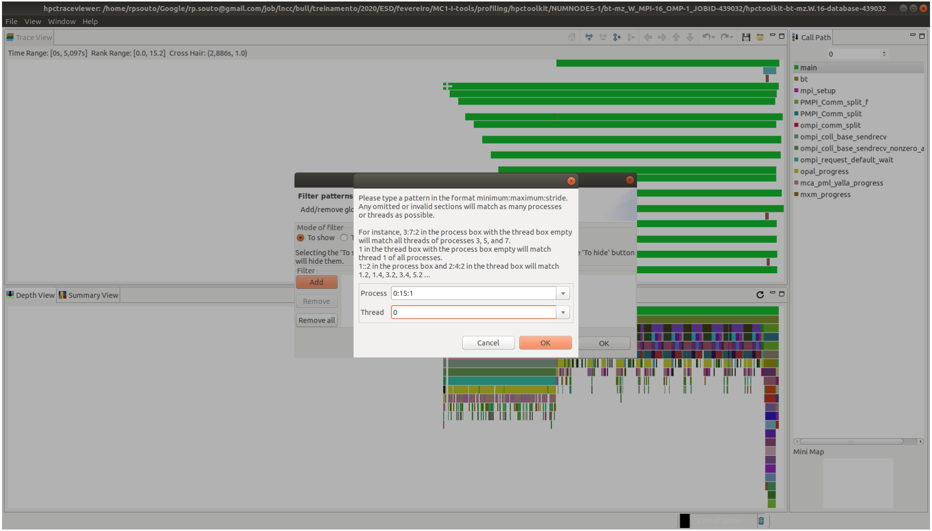
● To show ○ To hide

Selecting the 'To show' radio button will show matching processes, while selecting the 'To hide' button will hide them.

Filter

Visualizando no **hpctraceview**

–nodes=1 –ntasks=16



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Time Range: [0s, 5,097s] Rank Range: [0.0, 15.2] Cross Hair: (2,886s, 1.0)

Filter patterns

Add/remove glo

Mode of filter: ● To show ○ T

Selecting the 'To s … 'To hide' button will hide them.

Please type a pattern in the format minimum:maximum:stride. Any omitted or invalid sections will match as many processes or threads as possible.

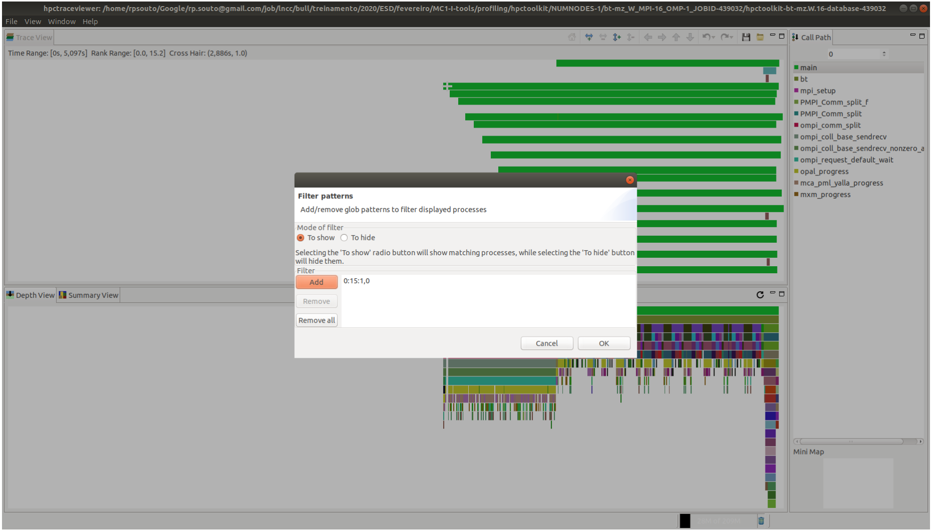
For instance, 3:7:2 in the process box with the thread box empty will match all threads of processes 3, 5, and 7.
1 in the thread box with the process box empty will match thread 1 of all processes.
1::2 in the process box and 2:4:2 in the thread box will match 1.2, 1.4, 3.2, 3.4, 5.2 ...

Process: 0:15:1

Thread: 0

Visualizando no `hpctraceview`

–nodes=1 –ntasks=16



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Time Range: [0s, 5,097s] Rank Range: [0.0, 15.2] Cross Hair: (2,886s, 1.0)

Filter patterns

Add/remove glob patterns to filter displayed processes

Mode of filter

● To show ○ To hide

Selecting the 'To show' radio button will show matching processes, while selecting the 'To hide' button will hide them.

Filter

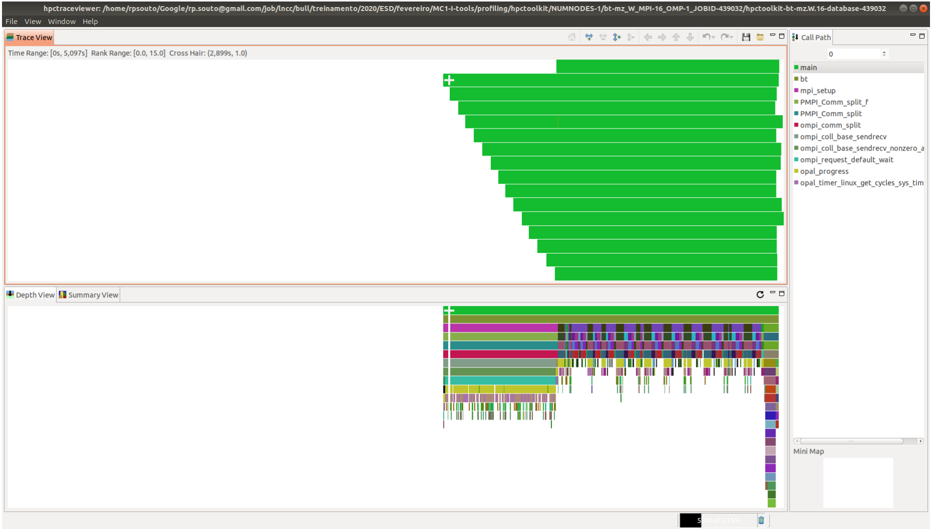
0:15:1,0

Call Path

- 🟩 main
- 🟩 bt
- 🟪 mpi_setup
- 🟩 PMPI_Comm_split_f
- 🟦 PMPI_Comm_split
- 🟥 ompi_comm_split
- 🟩 ompi_coll_base_sendrecv
- 🟩 ompi_coll_base_sendrecv_nonzero_a
- 🟦 ompi_request_default_wait
- 🟨 opal_progress
- 🟫 mca_pml_yalla_progress
- 🟫 mxm_progress

Visualizando no `hpctraceview`

`-nodes=1 -ntasks=16`



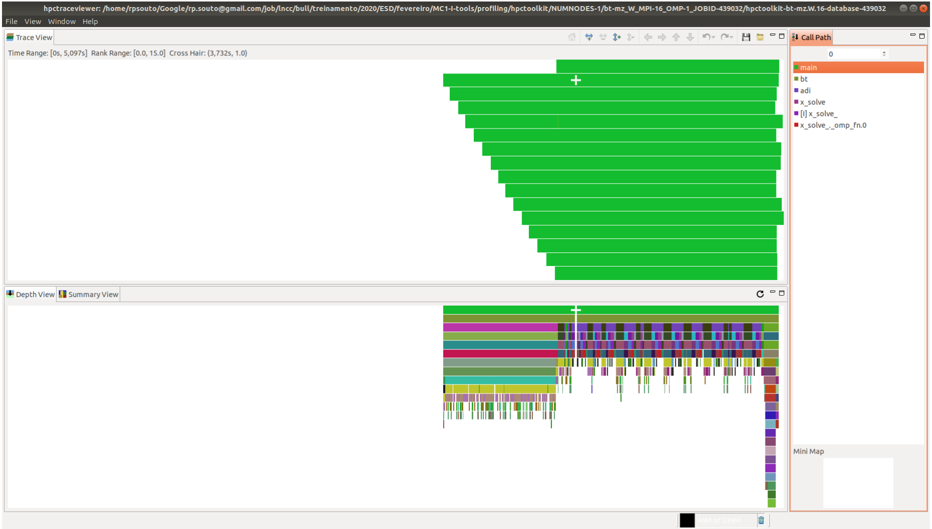
hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Time Range: [0s, 5,097s] Rank Range: [0.0, 15.0] Cross Hair: (2,899s, 1.0)

- main
- bt
- mpi_setup
- PMPI_Comm_split_f
- PMPI_Comm_split
- ompi_comm_split
- ompi_coll_base_sendrecv
- ompi_coll_base_sendrecv_nonzero_a
- ompi_request_default_wait
- opal_progress
- opal_timer_linux_get_cycles_sys_tim

Visualizando no **`hpctraceview`**

`--nodes=1 --ntasks=16 – função main`



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

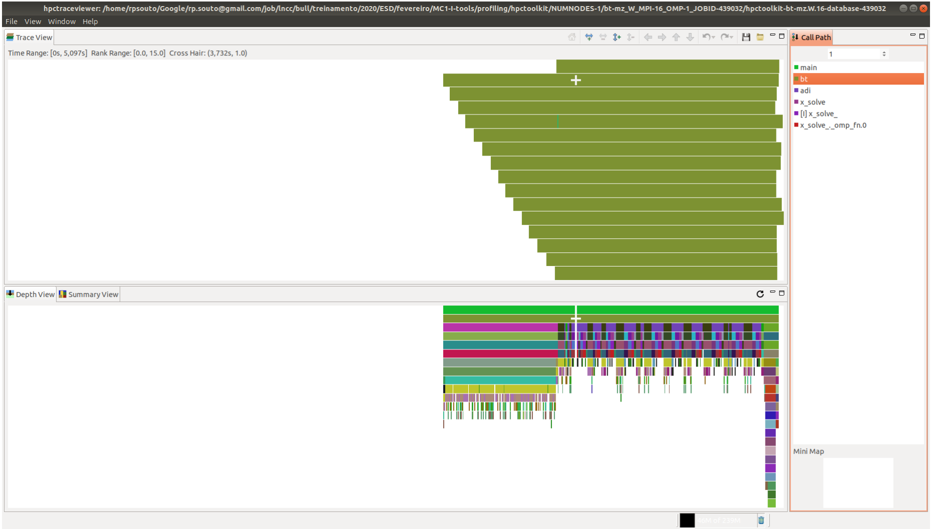
Time Range: [0s, 5,097s] Rank Range: [0.0, 15.0] Cross Hair: (3,732s, 1.0)

Call Path: 0

- 🟩 main
- 🟩 bt
- 🟪 adi
- 🟪 x_solve
- 🟪 [I] x_solve_
- 🟥 x_solve_._omp_fn.0

Visualizando no `hpctraceview`

`--nodes=1 --ntasks=16` – função **bt**



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Time Range: [0s, 5,097s] Rank Range: [0.0, 15.0] Cross Hair: (3,732s, 1.0)

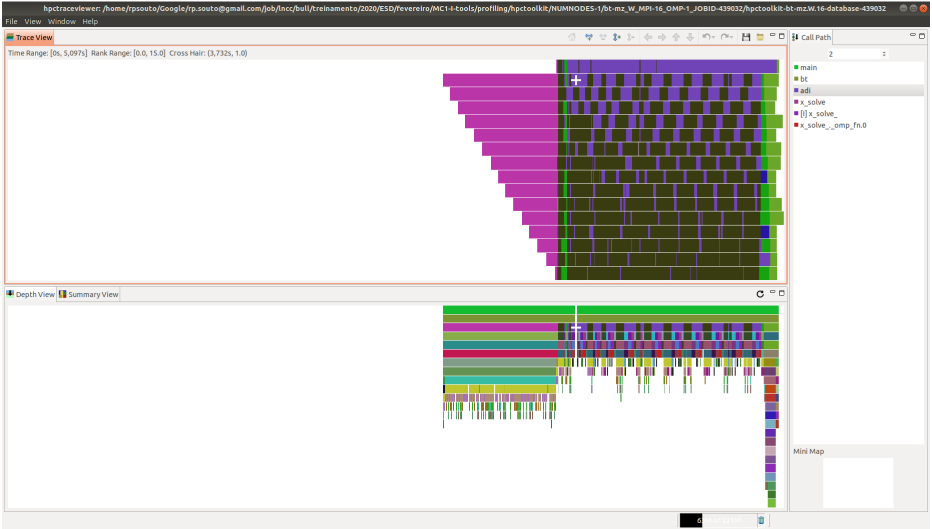
Call Path: 1

- main
- bt
- adi
- x_solve
- [I] x_solve_
- x_solve_._omp_fn.0

46M of 239M

Visualizando no **`hpctraceview`**

`-nodes=1 -ntasks=16` – função **`adi`**



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

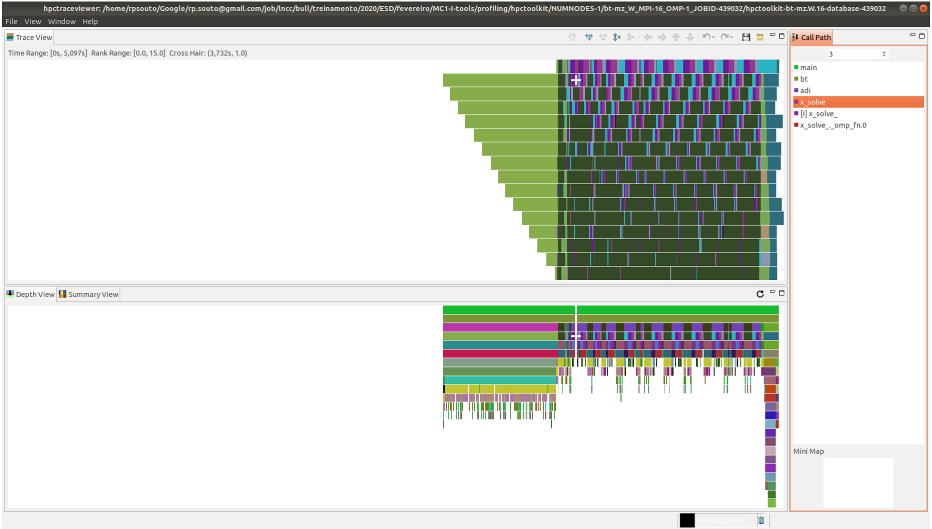
Time Range: [0s, 5,097s] Rank Range: [0.0, 15.0] Cross Hair: (3,732s, 1.0)

Call Path: 2

- main
- bt
- adi
- x_solve
- [I] x_solve_
- x_solve_._omp_fn.0

Visualizando no **`hpctraceview`**

`--nodes=1 --ntasks=16` – função **`xsolve`**



hpctraceviewer: /home/rpsouto/Google/rp.souto@gmail.com/job/lncc/bull/treinamento/2020/ESD/fevereiro/MC1-I-tools/profiling/hpctoolkit/NUMNODES-1/bt-mz_W_MPI-16_OMP-1_JOBID-439032/hpctoolkit-bt-mz.W.16-database-439032

Time Range: [0s, 5,097s] Rank Range: [0.0, 15.0] Cross Hair: (3,732s, 1.0)