Echipa:

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KU1K

Descrierea proiectului

KU1K
is a set of tools for 4D,5D and 6D compact U(1) lattice gauge theory Monte Carlo simulation using the Skipis-Vantzos algorithm. As the calculations involved, even for the 4D case, are consuming, the project is modular so as to run on the Grid.

Structura proiectului

- Mapper
- Initializer
- Sweeper (TBC)
- Binner
- Bin2txt
- Cumulants (TBC)
- Meaner (TBC)
- Scripturi Python…

Modul: Mapper

- Modulul creează o latice necesară algoritmului Skipis-Vantzos, pentru un număr de dimensiuni spațiale și o dimensiune a laticei.
- Laticea este folosită de un algoritm de simulare Monte Carlo și este de dimensiune foarte mare.

Modul: Initializer

- Modulul creează o configurație inițială a laticei pentru prima rulare a algoritmului Monte Carlo.
- Configurația este fixă.

Modul: Sweeper (TBC)

- Modulul principal al proiectului
- Implementează algoritmul Monte Carlo și rulează simularea în mai multe iterații, pentru o anumită dimensiune spațială și a laticei.
- Folosește laticea generată de modulul mapper și o configurație (snapshot) predefinită sau generată de modulul initializer.

Modul: Binner

- Modulul creează o histogramă a unui fișier binar care poate fi folosită pentru analiza datelor obținute din simularea Monte Carlo.
- Rezultatul poate fi analizat cu utilitare ca GNUPlot sau Mathematica.

Modul: Bin2Txt

- Modulul procesează rezultatul binar returnat de modulul sweeper și generează un fișier text corespunzător acestuia, ce poate fi analizat cu utilitare ca GNUPlot sau Mathematica.

Modul: Meaner (TBC)

- Modulul calculează o medie a rezultatelor modulului sweeper.

Stadiu inițial

Module implementate:

- Mapper
- Initializer
- Binner 0.1
- Bin2Txt 0.1

Module neimplementate:

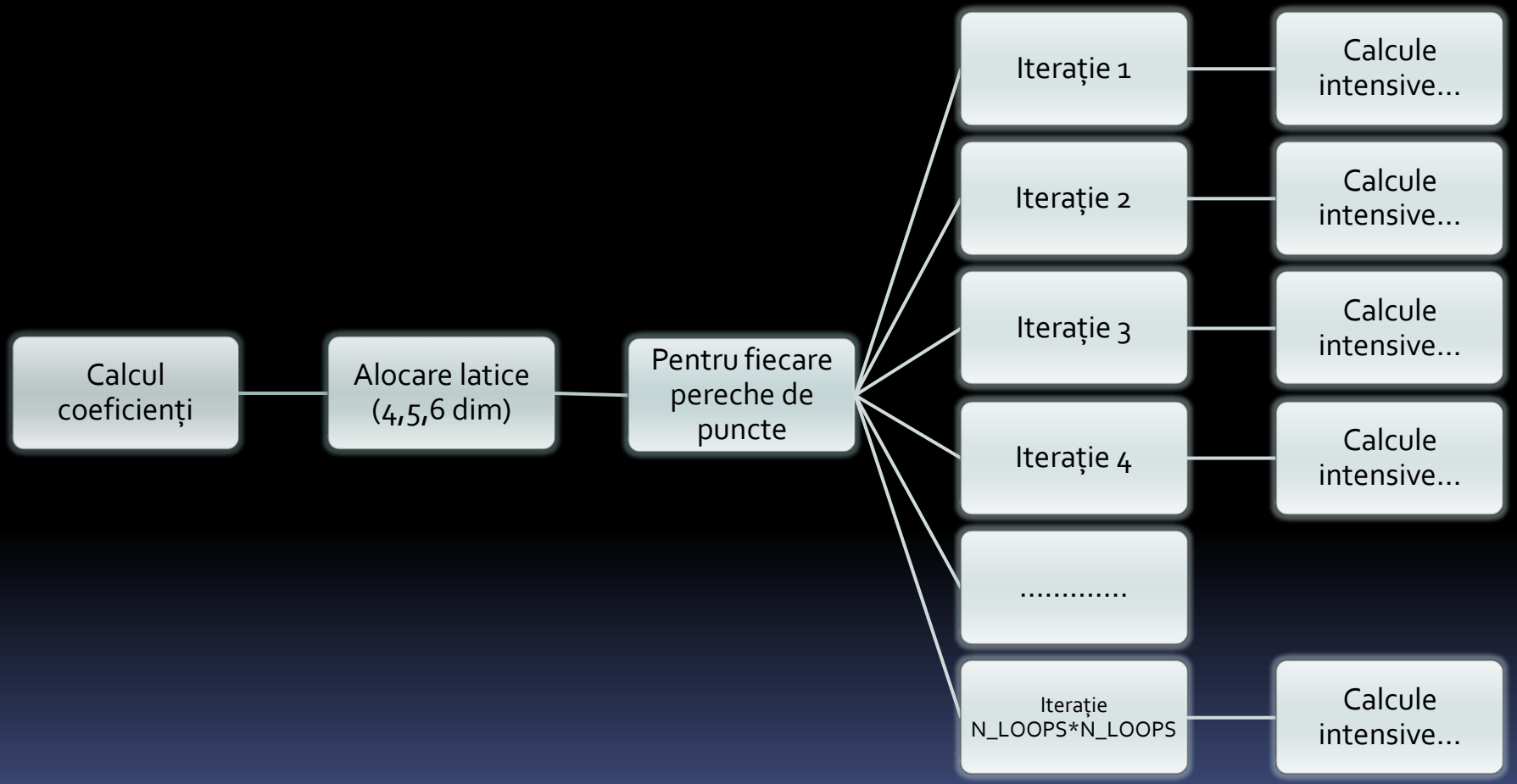
- Meaner
- Sweeper
- Cumulants

Toate modulele implementate prezintă variante seriale

Posibilități de paralelizare

- Modulul principal implementat este modulul mapper
- Mapper creează o latice cu 4, 5 sau 6 dimensiuni.
- Complexitatea algoritmului de generare este dedusă din:
  - $(L^D * D * (D-1)/2)^2$
  - $= (L^D * D^2)^2$

Structura programului



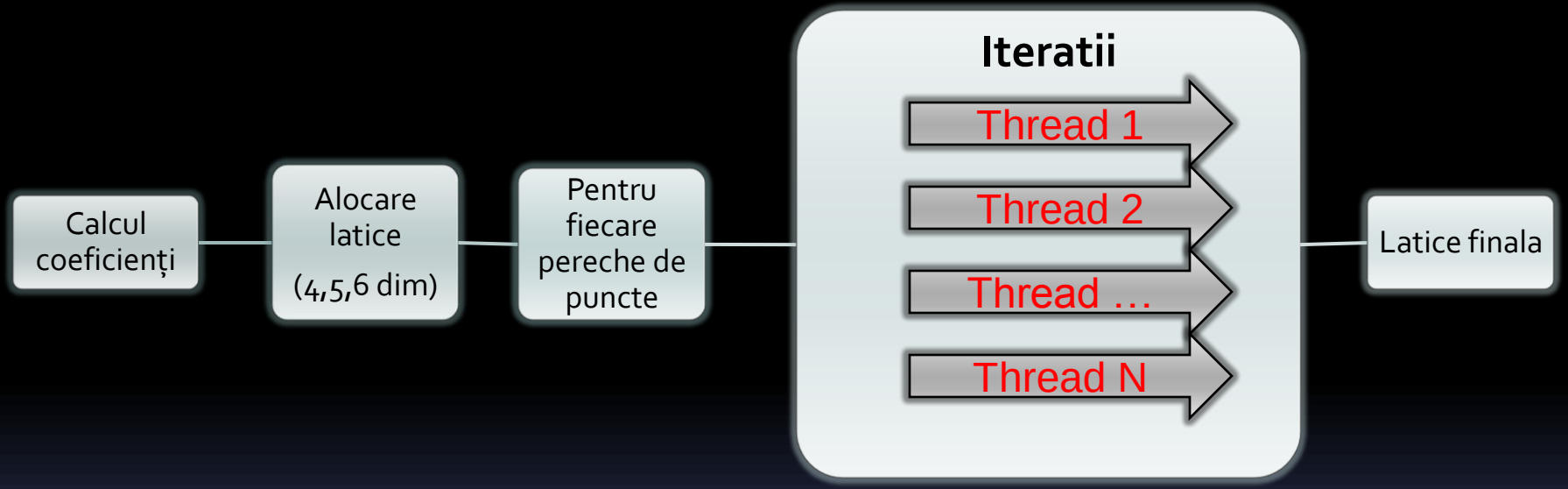
$$N\_LOOPS = (L^D * D * (D-1)/2)$$

Implementarea paralelizării

- Paralelizarea prin MPI nu s-a dovedit eficientă din cauza overhead-ului indus de schimbul de mesaje în contextul unei granularitati excesive.

- Am optat pentru paralelizarea prin OpenMP.

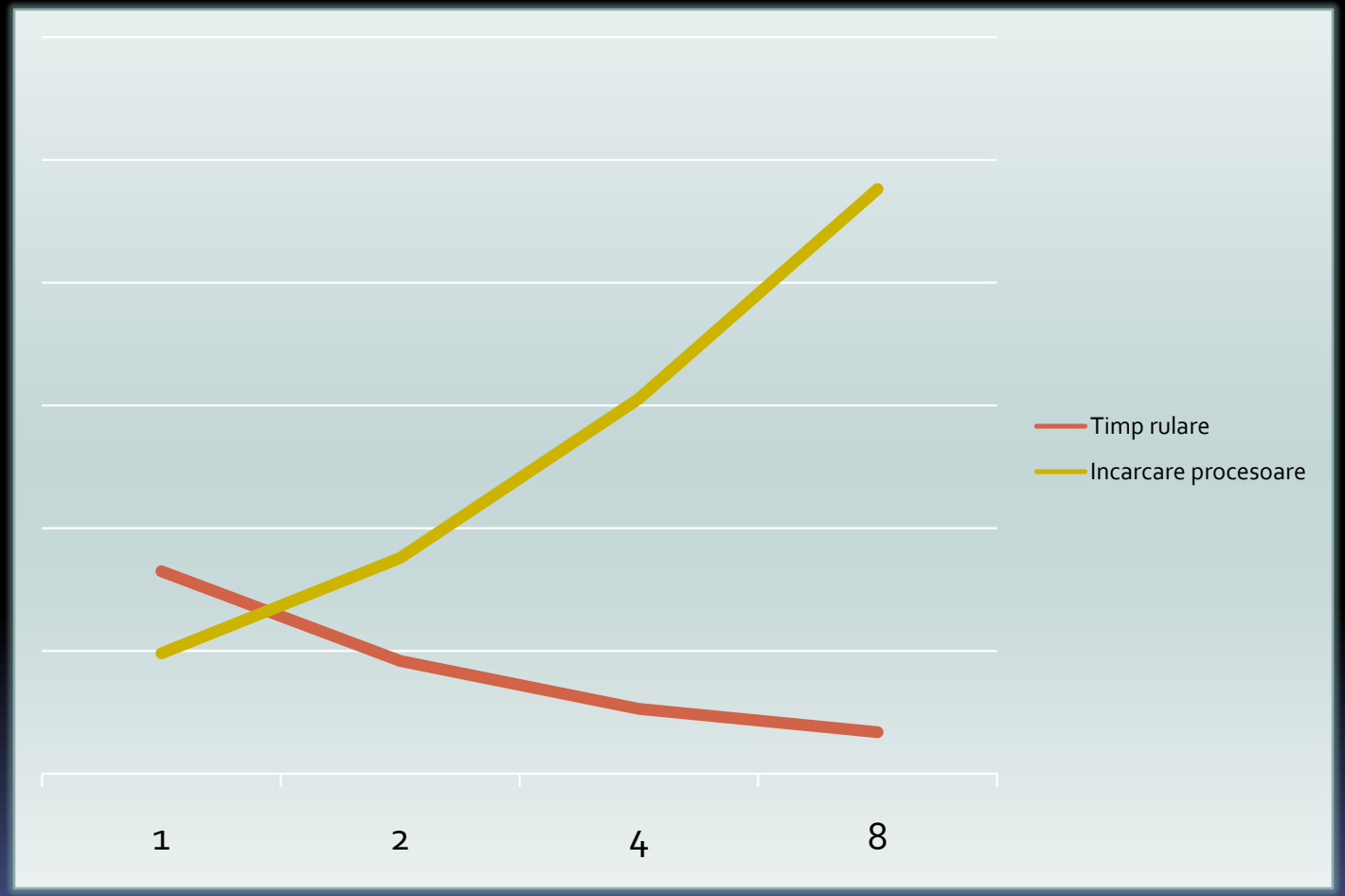
Paralelizare OpenMP



Statistici

	5D 4L			
Nr threaduri	1	2	4	8
Timp rulare	1.65	0.92	0.53	0.34
Încărcare	98.10%	176%	305.60%	476.40%
	5D 5L			
Nr threaduri	1	2	4	8
Timp rulare	14.15	7.95	4.49	2.38
Încărcare	99.60%	176%	313.10%	589.90%
	5D 6L			
Nr threaduri	1	2	4	8
Timp rulare	82.36	128.47	27.05	14.06
Încărcare	99.80%	83%	305.20%	586.70%

Statistici

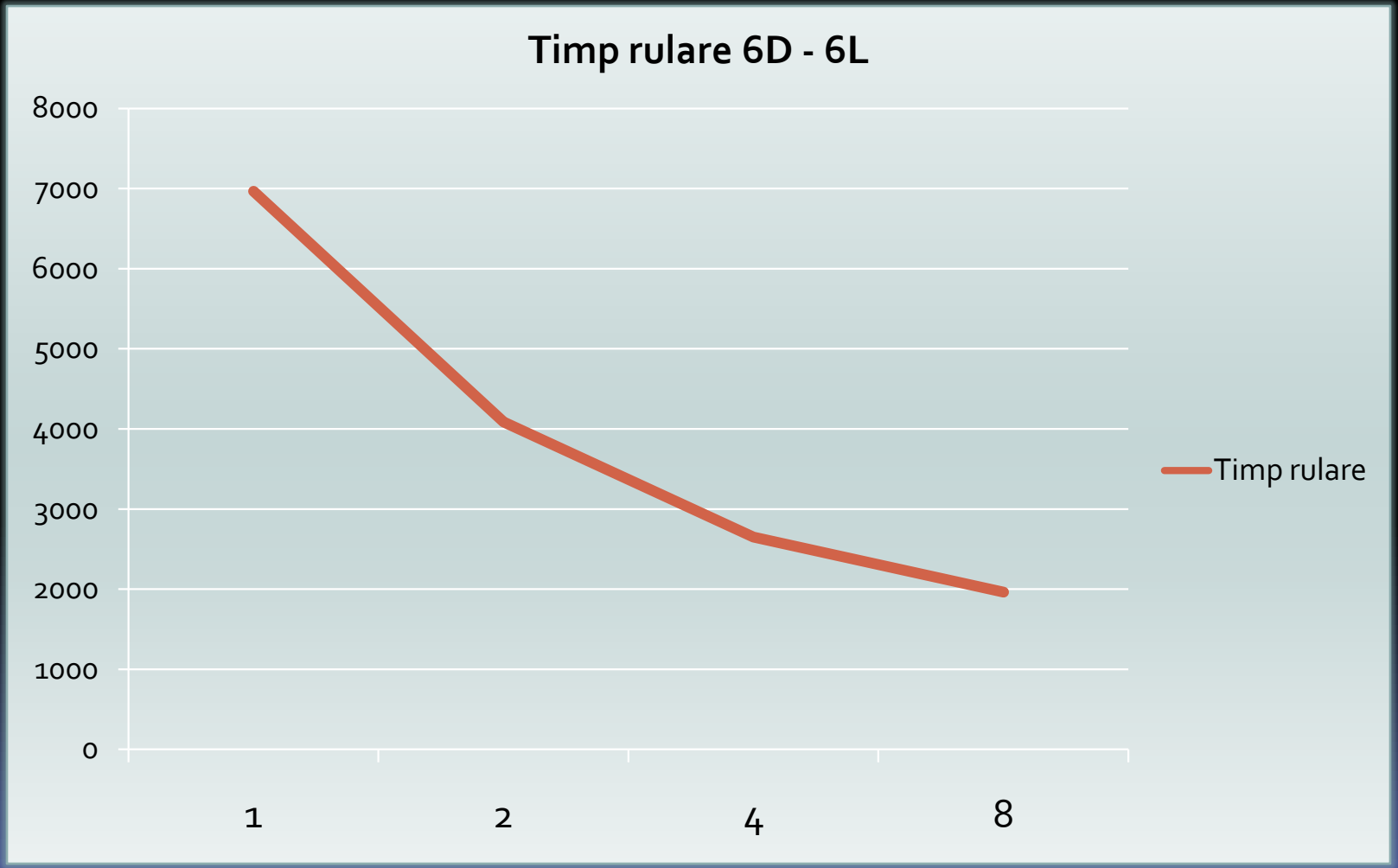


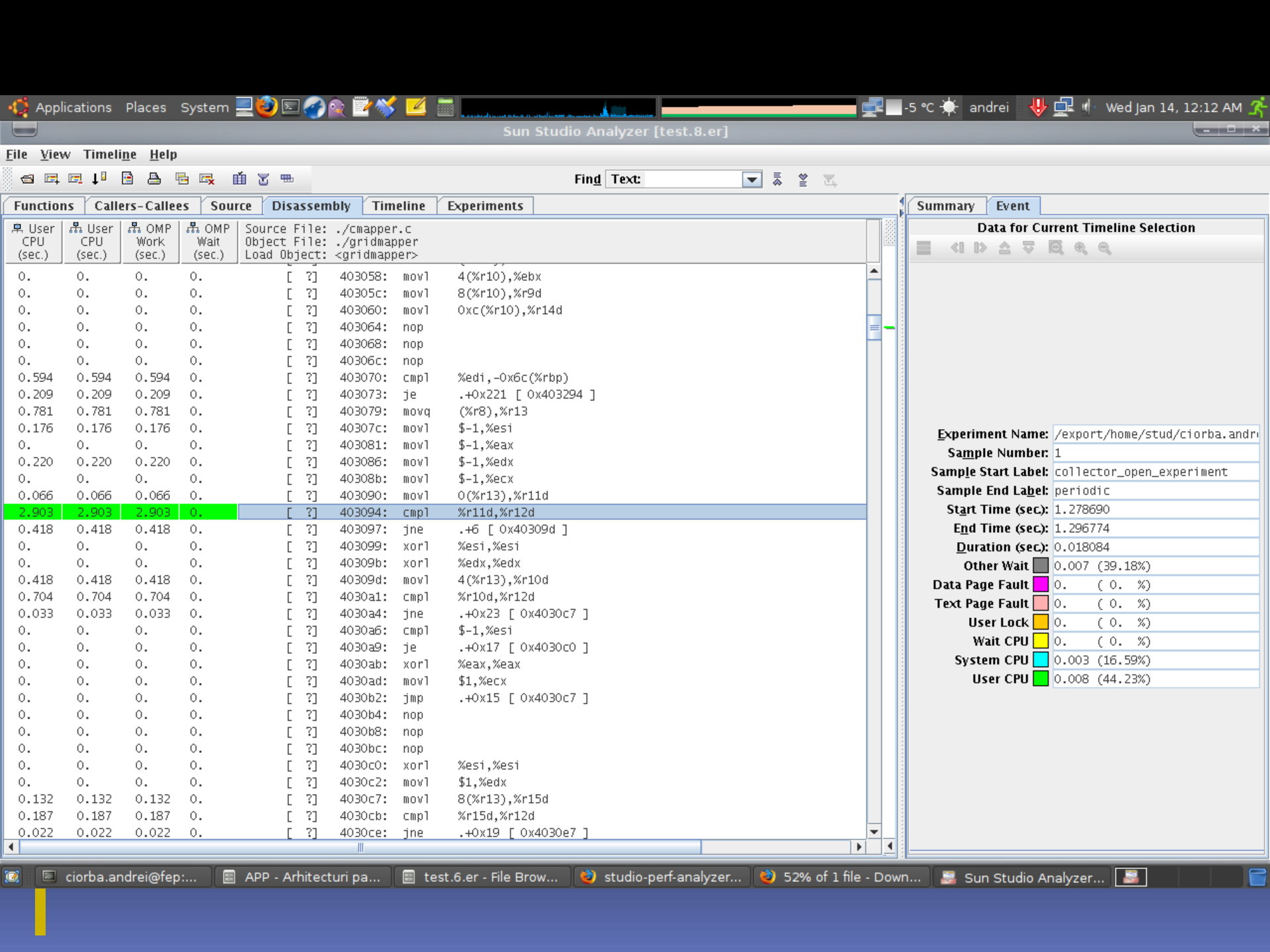
5 D – 4 L

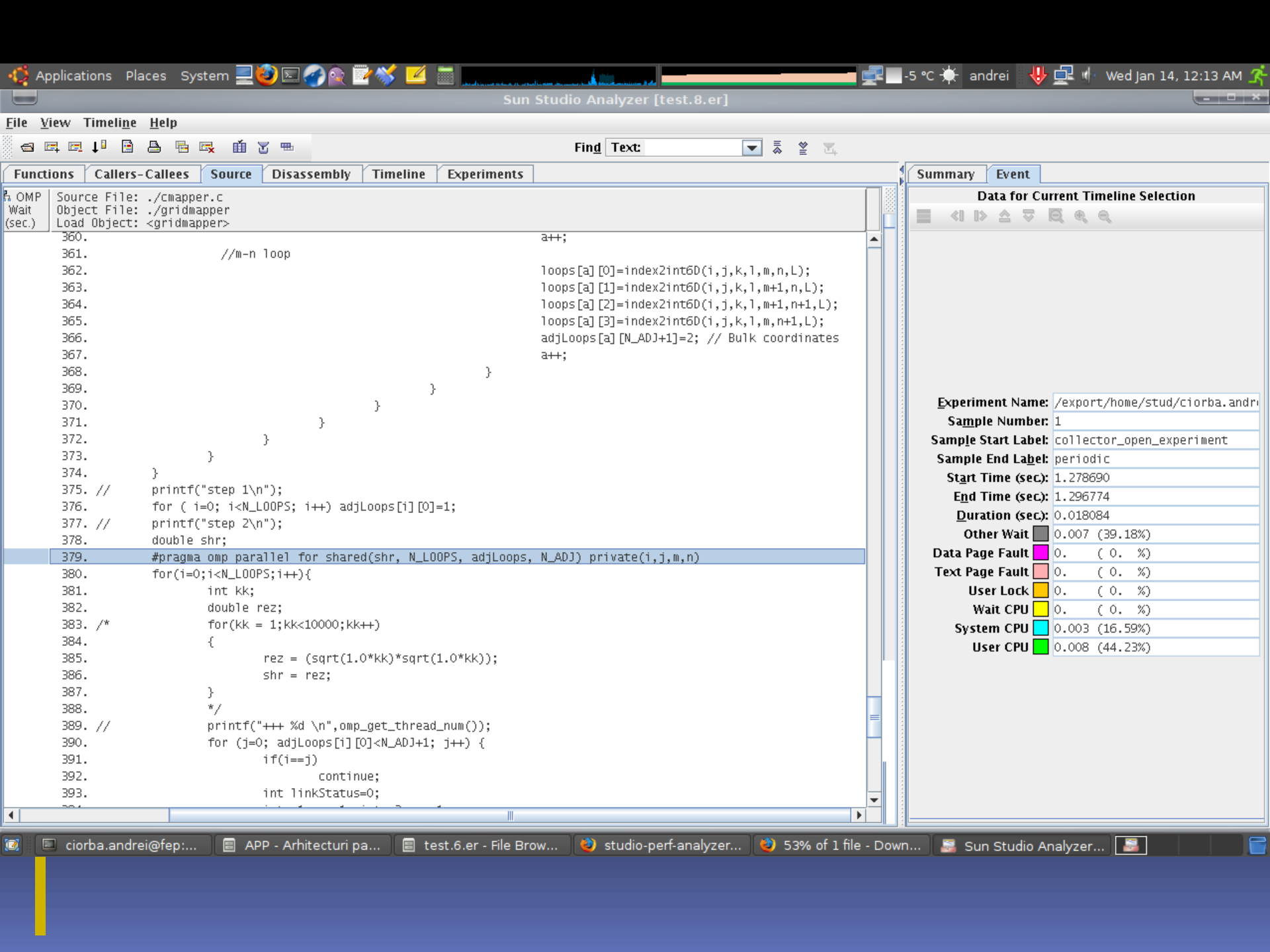
Statistici

	6D 4L			
Nr threaduri	1	2	4	8
Timp rulare	56.7	31.39	17.38	9.05
Încărcare	99.70%	181%	326.80%	628.20%
	6D 5L			
Nr threaduri	1	2	4	8
Timp rulare	804.76	457.16	262.1	186.14
Încărcare	99.90%	177%	313.80%	490.00%
	6D 6L			
Nr threaduri	1	2	4	8
Timp rulare	6967.18	4086	2648.4	1960.28
Încărcare	99.90%	172%	310.70%	598.70%

Statistici


Timp rulare 6D - 6L
8000
7000
6000
5000
4000
3000
2000
1000
0
1
2
4
8
Timp rulare


Applications Places System
-5 °C andrei Wed Jan 14, 12:12 AM
Sun Studio Analyzer [test.8.er]
File View Timeline Help
Find Text:
Functions Callers-Callees Source Disassembly Timeline Experiments
Summary Event
Data for Current Timeline Selection
User CPU (sec.) | User CPU (sec.) | OMP Work (sec.) | OMP Wait (sec.) | Source File: ./cmapper.c Object File: ./gridmapper Load Object: <gridmapper>
0. 0. 0. 0. [?] 403058: movl 4(%r10),%ebx
0. 0. 0. 0. [?] 40305c: movl 8(%r10),%r9d
0. 0. 0. 0. [?] 403060: movl 0xc(%r10),%r14d
0. 0. 0. 0. [?] 403064: nop
0. 0. 0. 0. [?] 403068: nop
0. 0. 0. 0. [?] 40306c: nop
0.594 0.594 0.594 0. [?] 403070: cmpl %edi,-0x6c(%rbp)
0.209 0.209 0.209 0. [?] 403073: je .+0x221 [0x403294]
0.781 0.781 0.781 0. [?] 403079: movq (%r8),%r13
0.176 0.176 0.176 0. [?] 40307c: movl $-1,%esi
0. 0. 0. 0. [?] 403081: movl $-1,%eax
0.220 0.220 0.220 0. [?] 403086: movl $-1,%edx
0. 0. 0. 0. [?] 40308b: movl $-1,%ecx
0.066 0.066 0.066 0. [?] 403090: movl 0(%r13),%r11d
2.903 2.903 2.903 0. [?] 403094: cmpl %r11d,%r12d
0.418 0.418 0.418 0. [?] 403097: jne .+6 [0x40309d]
0. 0. 0. 0. [?] 403099: xorl %esi,%esi
0. 0. 0. 0. [?] 40309b: xorl %edx,%edx
0.418 0.418 0.418 0. [?] 40309d: movl 4(%r13),%r10d
0.704 0.704 0.704 0. [?] 4030a1: cmpl %r10d,%r12d
0.033 0.033 0.033 0. [?] 4030a4: jne .+0x23 [0x4030c7]
0. 0. 0. 0. [?] 4030a6: cmpl $-1,%esi
0. 0. 0. 0. [?] 4030a9: je .+0x17 [0x4030c0]
0. 0. 0. 0. [?] 4030ab: xorl %eax,%eax
0. 0. 0. 0. [?] 4030ad: movl $1,%ecx
0. 0. 0. 0. [?] 4030b2: jmp .+0x15 [0x4030c7]
0. 0. 0. 0. [?] 4030b4: nop
0. 0. 0. 0. [?] 4030b8: nop
0. 0. 0. 0. [?] 4030bc: nop
0. 0. 0. 0. [?] 4030c0: xorl %esi,%esi
0. 0. 0. 0. [?] 4030c2: movl $1,%edx
0.132 0.132 0.132 0. [?] 4030c7: movl 8(%r13),%r15d
0.187 0.187 0.187 0. [?] 4030cb: cmpl %r15d,%r12d
0.022 0.022 0.022 0. [?] 4030ce: jne .+0x19 [0x4030e7]
Experiment Name: /export/home/stud/ciorba.andr
Sample Number: 1
Sample Start Label: collector_open_experiment
Sample End Label: periodic
Start Time (sec.): 1.278690
End Time (sec.): 1.296774
Duration (sec.): 0.018084
Other Wait 0.007 (39.18%)
Data Page Fault 0. (0. %)
Text Page Fault 0. (0. %)
User Lock 0. (0. %)
Wait CPU 0. (0. %)
System CPU 0.003 (16.59%)
User CPU 0.008 (44.23%)
ciorba.andrei@fep:...
APP - Arhitecturi pa...
test.6.er - File Brow...
studio-perf-analyzer...
52% of 1 file - Down...
Sun Studio Analyzer...


Applications Places System
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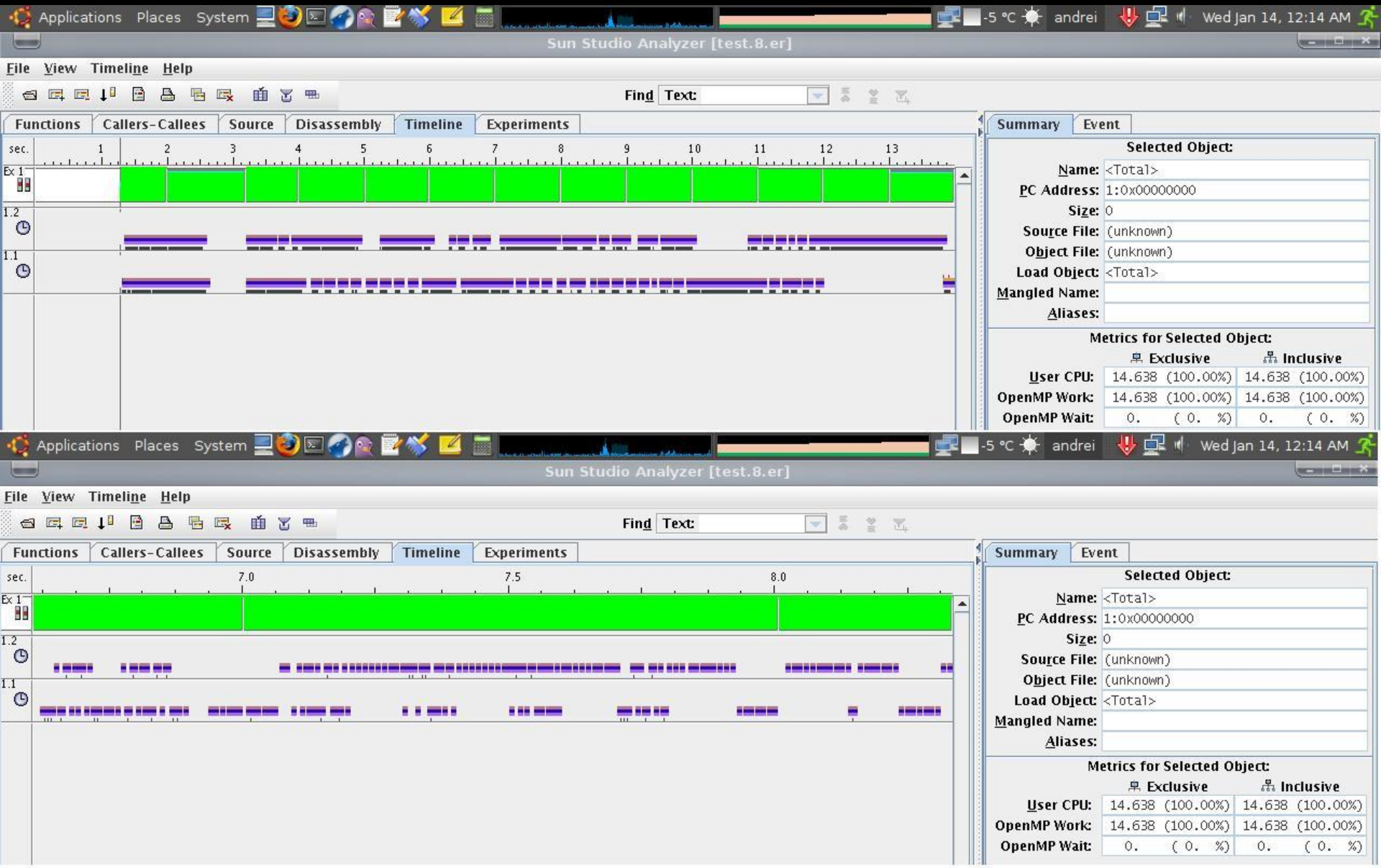
Sun Studio Analyzer [test.8.er]
File View Timeline Help
Find Text:
Functions Callers-Callees Source Disassembly Timeline Experiments
Summary Event
OMP Wait (sec.)
Source File: ./cmapper.c
Object File: ./gridmapper
Load Object: <gridmapper>
360. a++;
361. //m-n loop
362. loops[a][0]=index2int6D(i,j,k,l,m,n,L);
363. loops[a][1]=index2int6D(i,j,k,l,m+1,n,L);
364. loops[a][2]=index2int6D(i,j,k,l,m+1,n+1,L);
365. loops[a][3]=index2int6D(i,j,k,l,m,n+1,L);
366. adjLoops[a][N_ADJ+1]=2; // Bulk coordinates
367. a++;
368. }
369. }
370. }
371. }
372. }
373. }
374. }
375. // printf("step 1\n");
376. for (i=0; i<N_LOOPS; i++) adjLoops[i][0]=1;
377. // printf("step 2\n");
378. double shr;
379. #pragma omp parallel for shared(shr, N_LOOPS, adjLoops, N_ADJ) private(i,j,m,n)
380. for(i=0;i<N_LOOPS;i++){
381. int kk;
382. double rez;
383. /* for(kk = 1;kk<10000;kk++)
384. {
385. rez = (sqrt(1.0*kk)*sqrt(1.0*kk));
386. shr = rez;
387. }
388. */
389. // printf("+++ %d \n",omp_get_thread_num());
390. for (j=0; adjLoops[i][0]<N_ADJ+1; j++) {
391. if(i==j)
392. continue;
393. int linkStatus=0;
Data for Current Timeline Selection
Experiment Name: /export/home/stud/ciorba.andr
Sample Number: 1
Sample Start Label: collector_open_experiment
Sample End Label: periodic
Start Time (sec.): 1.278690
End Time (sec.): 1.296774
Duration (sec.): 0.018084
Other Wait 0.007 (39.18%)
Data Page Fault 0. (0. %)
Text Page Fault 0. (0. %)
User Lock 0. (0. %)
Wait CPU 0. (0. %)
System CPU 0.003 (16.59%)
User CPU 0.008 (44.23%)
ciorba.andrei@fep:...
APP - Arhitecturi pa...
test.6.er - File Brow...
studio-perf-analyzer...
53% of 1 file - Down...
Sun Studio Analyzer...


Applications Places System
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Sun Studio Analyzer [test.8.er]
File View Timeline Help
Find Text:
Functions Callers-Callees Source Disassembly Timeline Experiments
sec. 1 2 3 4 5 6 7 8 9 10 11 12 13
Ex 1
1.2
1.1
Summary Event
Selected Object:
Name: <Total>
PC Address: 1:0x00000000
Size: 0
Source File: (unknown)
Object File: (unknown)
Load Object: <Total>
Mangled Name:
Aliases:
Metrics for Selected Object:
Exclusive Inclusive
User CPU: 14.638 (100.00%) 14.638 (100.00%)
OpenMP Work: 14.638 (100.00%) 14.638 (100.00%)
OpenMP Wait: 0. (0. %) 0. (0. %)
Applications Places System
-5 °C andrei Wed Jan 14, 12:14 AM
Sun Studio Analyzer [test.8.er]
File View Timeline Help
Find Text:
Functions Callers-Callees Source Disassembly Timeline Experiments
sec. 7.0 7.5 8.0
Ex 1
1.2
1.1
Summary Event
Selected Object:
Name: <Total>
PC Address: 1:0x00000000
Size: 0
Source File: (unknown)
Object File: (unknown)
Load Object: <Total>
Mangled Name:
Aliases:
Metrics for Selected Object:
Exclusive Inclusive
User CPU: 14.638 (100.00%) 14.638 (100.00%)
OpenMP Work: 14.638 (100.00%) 14.638 (100.00%)
OpenMP Wait: 0. (0. %) 0. (0. %)