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Parallelized Analysis Using Subdural Interictal EEG

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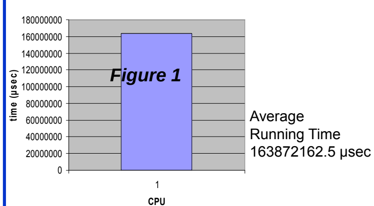
I. Research Overview and Outcome

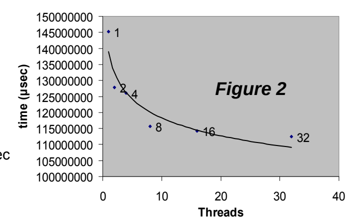
I.I Introduction

The data used in this study was obtained sequentially from a significant sample of 8 patients who underwent two-stage epilepsy surgery with subdural recordings. The age of the subjects varied from 3 to 17 years. The number and configuration of the subdural electrodes differed between subjects, and was determined by clinical judgment at the time of implantation. Grid, strip, and depth electrodes were used, with a total number of contacts varying between 20 and 88. The amount of data available for analysis was influenced by its recording duration, and by the degree to which the interictal EEG was "pruned" prior to storage in the permanent medical record. The iEEG data was recorded at Miami's Children Hospital (MCH) using XLTEK Neuroworks Ver.3.0.5, equipment manufactured by Excel Tech Ltd. Ontario, Canada. The data was collected at 500 Hz sampling frequency and filtered to remove the DC component. All data sets for this particular study were iEEG segments of 20 minutes approximately (200 Megabytes). Three algorithms were created.

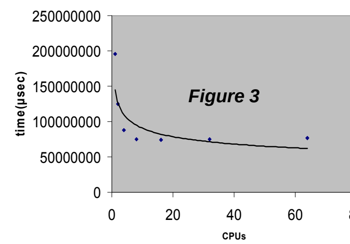
I.II Data

- The sequential algorithm was ran 10 times and the results averaged. This implementation was done to have a basis of comparison with the other two. Results are shown in figure 1.
- The multithreaded algorithm was ran with 1,2,4,8,16, and 32 threads. Running times were recorded and averaged. Results are shown in figure 2.
- The parallelized algorithm was the hardest to code and the more interesting. The EEG data was partitioned by the algorithm among several CPUs and MPI (Message Passing Interface) was used to synchronize the processing. This algorithm was executed with 1,2,4,8,16,34, and 64 CPUs. Figure 3 shows the results.





Threads	time
1	145184192
2	127785492
4	125973272
8	125973272
16	114281754
32	112527251



CPUs	Time (ms)
1	195413731
2	124914390
4	87626182
8	75209535
16	74068303
32	75246532
64	77009326

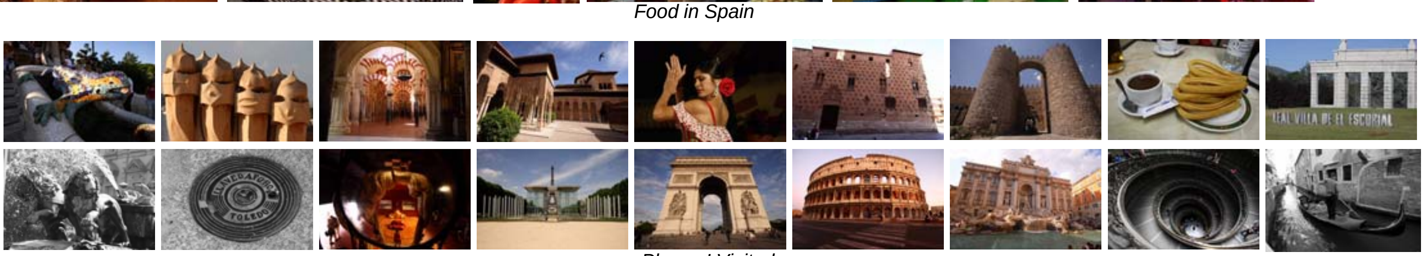
I.III Discussion

Our results show that, as expected, the multithreaded and parallelized perform better than the sequential algorithm. The multithreaded algorithm improves as more threads are added, but more than 4 threads do not provide a significant improvement, we believe that this is because the overhead of creating the threads and address spaces takes CPU cycles which could have been used to process the data. Last, our parallel algorithm has a significant improvement when 4 CPUs are used. However, more than 7 do not provide a significant improvement. It is interesting to observe that the runtime with 64 CPUs is larger than the runtime with 8. We think this occurs because breaking the array into 64 parts is more expensive than the computational time of FFTW. The computational time was cut in about 50% by using the parallel implementation (over the sequential). This time saving might provide the leverage required to predict a seizure with enough time to warn a patient.

II. International Experience

International Collaborators

Food in Spain



Places I Visited

Pire allowed me to learn about other cultures and create links with people in other parts of the world. Professionally I am now a better researcher, with experience in parallel computing. I know now that I can adapt to any research and work environment.

III. Acknowledgement

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