

Rahulkumar Gayatri

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Summary

- Experience in sequential and parallel algorithm development.
 1. Designed and implemented a Breadth First Search (BFS) algorithm that takes advantage of low memory on IBM's Cell B/E. processor.
 2. Parallelized Graph500 benchmarks, SPECfem3D, linear iterative solvers on an SMP machine using the StarSs programming model.
- Experience in the areas of compiler and runtime development for parallel programming models.
 1. Introduced new compiler directives and the necessary runtime support in the StarSs framework to handle synchronization of multiple threads.
- Knowledge in the area of Transactional Memory framework.
 1. Worked extensively with the Software Transactional Memory (STM).
- Experience in parallelizing applications using Pthreads, OpenMP, OMPs and MPI programming models.
- Familiar with exploiting the underlying processor architecture to enhance the application performance.
- Experience in collaborating with other researchers and engineers across organizations to achieve the set goals.
- Familiarity with tools like valgrind profiler, gdb, google performance tools, latex software and version control tools such as git.
- Currently working on Moose, a simulation model of neural connections in human brain.
 1. It is a multiscale problem which provides an opportunity for both distributed and thread-based parallelism.
- Basic knowledge of GPU, Cuda Programming and Intel Xeon Phi.

Education

1. **Doctor of Philosophy (PhD) in Computer Science** (2015)
Barcelona Supercomputing Center
Thesis Title - "Increasing Parallelism through Speculation in Task-Based Programming Model."
2. **Master of Technology** (2009)
Specialization in Computer Science, Sri Sathya Sai University (SSSU)
3. **Master of Science** (2007)
Specialization in Computer Science, SSSU
4. **Bachelor of Science** (2005)
Specialization in Mathematics, SSSU

Publications

1. *Rahul Kumar Gayatri, Rosa M. Badia, Eduard Ayguade* "Loop level speculation in a task based programming model."
2. *Rahul Kumar Gayatri, Rosa M. Badia, Eduard Ayguade* "Transactional access to shared memory in StarSs, a task based programming model."
3. *Rahul Kumar Gayatri, Rosa M. Badia, Eduard Ayguade* "Analysis of the overheads incurred due to speculation in a task based programming model."
4. *Roberto Giorgi et al.* "TERAFLUX: Harnessing dataflow in next generation teradevices."
5. *Rahul Kumar Gayatri, Rosa M. Badia, Eduard Ayguade* "Presented a Poster on the benefits of using CellSs (a programming model for Cell Processor) in the ACACES 2010 summer school of HiPEAC."
6. *Rahul Kumar Gayatri, Pallav Baruah* "Parallelizing Breadth First Search Using Cell BE, HiPC, Student Symposium, 2008"

Projects

* - current project

1. **Parallelization of Moose, a Multiscale Object-Oriented Simulation Environment***

- (a) It is a simulation environment for Neural Systems. It operates from the level of stochastic chemical computation to multicompartment single-neuron model.
- (b) The framework uses numerical solvers that solve the chemical and electrical reactions between cells at every time-step.
- (c) A cell is divided into multiple compartments for simplicity and the solvers are used on each of the compartments. This provides scope for parallelization, where the computation on different compartments can be parallelly executed on different threads.
- (d) At present, I am working on exploiting this parallelism in a thread-based environment.
- (e) The focus is on pthread and OpenMP based implementations to compare the results and choose the best programming model for the framework.

2. **Doctoral Thesis -**

- (a) Focussed in the area of parallel programming models.
- (b) Provides compiler and runtime support for thread synchronization in StarSs, a task-based programming model.
- (c) The work explains and proves the advantage of speculative thread synchronization methods over the traditional locks and barriers based synchronization.
- (d) Software Transactional Memory (STM) was used to achieve the speculative behavior.
- (e) Integrated the TinySTM (lighweight STM library), into the StarSs framework.
- (f) Introduced compiler extensions that the programmers can use to notify the framework of a critical memory update.

- (g) Implemented the corresponding runtime support for the above feature which maintains application correctness and consistency.
- (h) Extended the above idea to speculatively create and schedule tasks in the StarSs framework.
- (i) Implemented the said feature (compiler and associated runtime support) that allows tasks to be optimistically scheduled ahead in time.
- (j) The results of such tasks are committed only after their validity in the execution flow can be guaranteed.
- (k) Ported benchmarks and scientific applications on multi-cores using the StarSs framework, where the above mentioned features were used for performance improvement.
- (l) Papers published in this project: [1],[2] and [3].

3. **StarSs** -

- (a) A task-based programming model to make parallel programming easier.
- (b) The framework comprises of compiler directives and the associated runtime support.
- (c) My contribution to the programming model was to maintain the runtime framework and resolve conflicts when new directives and their required implementation was introduced.
- (d) My focus was on SMPs (SMP Super Scalar), the StarSs implementation for Symmetric Multiprocessors (SMPs).
- (e) I also worked on design and implementation of parallel applications using the framework for the StarSs application repository.

4. **Teraflux** -

- (a) It was a project supported and funded by the European Union. The focus of the project was to exploit dataflow parallelism in a Teracomputing device.
- (b) It proposes a set of programming model, compiler analysis and a scalable reliable architecture to harness large scale parallelism in an efficient way.
- (c) The project was a collaboration of leading research centers and industries in the European Union. My participation in the project was through Barcelona Supercomputing Center.
- (d) My contribution to the project was in the area of programming models.
- (e) I contributed to the mechanisms that handle concurrent memory access to shared memory.
- (f) An STM-based concurrency control mechanism was implemented to handle critical memory updates.
- (g) Papers published in this project: paper [4].

5. **MTech Thesis** -

- (a) Designed and implemented an efficient Breadth First Search (BFS) algorithm on IBM's Cell.B.E architecture.
- (b) The implementation exploited memory locality to maximize the use of limited storage capacity of the architectures SPE's (slave processors).
- (c) Poster[5] presented the results achieved in this project.

Professional Career

1. Doctoral student at Barcelona Supercomputing Center
September, 2009 - March 2015
2. Technical Specialist, HPC, Wipro Infotech
September 2015 - Present day

Honors

Received a Pre-Doctoral scholarship, FI AGAUR grant, by Generalitat de Catalunya

Programming Languages and Models

<u>Languages:</u>	C,C++ , python(basic)
<u>Scripting:</u>	Shell, LaTeX, Sed, awk, gnuplot
<u>Programming Models:</u>	StarSs, OpenMP, Pthreads, MPI, STM
<u>Operating Systems:</u>	Microsoft Windows, Linux
<u>Software:</u>	Eclipse, Visual Studio 2010, GIT
<u>Profiling Tools:</u>	gdb, Valgrind, google-performance tools

References

1. *Rosa Maria Badia*, Project and group manager at Barcelona Supercomputing Center.
Relation: PhD supervisor, email: rosa.m.badia@bsc.es,
Web-page: <http://personals.ac.upc.es/rosab/>
2. *Eduard Ayguad*, Computer Sciences Department Associate Director at Barcelona Supercomputing Center.
Relation PhD supervisor, email: eduard.ayguade@bsc.es,
Web-page: <http://people.ac.upc.es/eduard/>
3. *Pieter Bellens*, Modelling engineer at ArcelorMittal, Ghent, Belgium
Relation: Colleague at Barcelona Supercomputing Center, email: pbellens@gmail.com