**Vivek Kale**

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**U.S. Citizen**

**Education:**

Lawrence Scholar at Lawrence Livermore National Laboratory

PhD in Computer Science University of Illinois at Urbana-Champaign

GPA: 3.95/4.00

**Advisor:**William Gropp

**Focus:** Dynamic scheduling for multi-core architectures.

**General Area of Interest:** High-Performance Scientific Computing, Computer Architecture, Parallel Computation, work stealing, auto-tuning, dense linear algebra, computational physics simulations.

***Overview of Work:*** I have worked on low-overhead dynamic scheduling strategies for performance tuning of MPI+OpenMP codes on next-generation clusters of SMPs. These low-overhead scheduling strategies aim to achieve the best balance between load balance and locality, two important characteristics of MPI+OpenMP code that help to obtain good performance for next-generation clusters of SMPs. The techniques have been applied to dense matrix factorization codes, specifically Communication-avoiding LU and Communication-avoiding QR. I have applied the strategies to regular mesh computations and Lattice-Boltzmann simulations, and most recently, n-body simulations. The scheduling strategies developed can be beneficial to mitigate the amplification problem, a problem shown to cause serious performance bottlenecks for bulk-synchronous and loosely synchronous MPI applications running on next-generation exa-scale machines or the cloud.

**Publications:**

1. Vivek Kale, Simplice Donfack, Laura Grigori, William D. Gropp. ***Balancing the Tradeoff Between Load Balancing and Locality to Improve Performance of Scientific Applications.*** SC' 14. New Orleans, LA.

1. Vivek Kale, Amanda Peters Randles, William D. Gropp. ***Locality-Optimized Mixed Static/Dynamic Scheduling for Load Balancing on SMPs****.* EuroMPI/ASIA 2014. Kyoto, Japan.
2. Vivek Kale, Todd Gamblin, Torsten Hoefler, Bronis R. de Supinski, William D. Gropp. ***Slack-conscious Lightweight Loop Scheduling for Scaling Past the Noise Amplification Problem****.* SC ‘12 Poster. Salt Lake City, Utah.
3. Simplice Donfack, Vivek Kale, Laura Grigori, William D. Gropp. ***Hybrid Static/Dynamic Scheduling for Already Optimized Dense Matrix Factorizations***. IPDPS 2011. Shanghai, China.
4. Vivek Kale, Abhinav Bhatele, William D. Gropp. ***Weighted Locality-Sensitive scheduling for Noise Mitigation on Multi-core Clusters.***HiPC 2011. Bangalore, India.
5. Vivek Kale, William D. Gropp. ***Load Balancing for Regular Meshes on a Cluster of SMPs with MPI.*** EuroMPI ’10. Stuttgart, Germany. *(Selected as a Best Paper).*
6. Torsten Hoefler, James Dinan, Darius Buntinas, Pavan Balaji, Brian Barrett, Ron Brightwell, William Gropp, Vivek Kale, Rajeev Thakur *.* ***MPI+MPI: A New Hybrid Approach to Parallel Programming with MPI Plus Shared Memory*.** EuroMPI ’12. Madrid, Spain.
7. Amanda Peters Randles, Vivek Kale, Jeff Hammond, William D. Gropp, Efthimios Kaxiras. ***Performance Analysis of the Lattice Boltzmann Model Beyond Navier-Stokes.*** IPDPS 2013. Boston, MA.

**Experience:**

**Lawrence Livermore National Laboratory                      Lawrence Scholar                    Feb 2012 – Jun 2014**

* Created a scheduler library framework to support hybrid programming, to provide interface between two different runtimes. Developed support for multi-level parallelism, to provide an "interface" between MPI and OpenMP.
* Discussed Performance modeling for PF3D.
* Create new schedulers that can be used through specifying it through the 'schedule' clause in OpenMP.
* Designed generalized n-stage scheduling strategy, where in the last stage of the scheduler, load balancing could occur across nodes.
* Developed idea for using adagio slack prediction scheme for runtime adjustment and control of scheduler, using upper-level MPI communication information to guide lower-level OpenMP scheduling decisions.

**Lawrence Livermore National Laboratory                         Scholar                    Jun 2011 - Sept 2011**

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**Lawrence Livermore National Laboratory           Scholar          Jun 2010 - Aug 2010**

* Added threading to a large MPI application involving FFT computation.
* Studied the behavior of these hybrid codes on a variety of large-scale machines.
* Documented strategies for performance tuning MPI+OpenMP applications in the context of PF3D.

**Goldman-Sachs     Summer Analyst Jun 2009 – Sept 2009**

* Implemented trading algorithms for a large-scale high performance system.
* Wrote code for simulating market conditions and testing system infrastructure.
* Analyzed basic performance bottlenecks of system infrastructure through simulation tests.

**Technical Skill Highlights:**

*Languages*:  C, C++, Java, LISP, Matlab, Mathematica, SQL, Perl

*Tools:*  Unix, C shell scripting, Perl, Subversion, Latex, autoconf, gnuplot

*Profiling Tools:*OpenSpeedshop, hpcToolkit, PMPI

*Platforms*:  multi-core architectures, clusters of SMPs, GPUs

*Runtimes:* Pthreads programming, MPI (mpich2), OpenMP (libgomp), Adaptive MPI, Berkeley UPC (gasnet)

*Libraries:* Petsc, Trillinos, HYPRE

*Applications:*  Renewable Energy (PF3D), LU/QR factorization, Computational Physics (MILC), NAS CG

**Additional:**

* 2010 Tau Beta Phi Academic Acheivement Award
* Presentations: SIAM PP 2010
* Workshop Publications:  IWMSE 2010, PGAS2011 (poster)
* Reviewer for International Conference on Supercomputing 2010 (under supervision of  Franck Cappello)
* Reviewer for PPoPP2011 (under supervision of Professor William Gropp).
* Parallel Patterns group (http://upcrc.illinois.edu and http://www.eecs.berkeley.edu/patterns)
* Berkeley UPC PGAS test suite development   (with Costin Iancu, Kathy Yelick).
* Involvement in OpenMP forum (with Bronis de Supinski)

**Coursework:**

- Renewable Energy: A+

- Software Engineering: A

- Artificial Intelligence: A

- Parallel Computer Architecture : A+ (99.89%  ,  highest grade in class)

- Advanced Distributed Systems :  A-

- Patterns in Parallel Programming: A

- Performance Tuning: A+

- Currently taking: Designing and Building applications for extreme-scale.

**Seminars:**

- Scientific and Parallel Computing

- Numerical Analysis seminar

- Biochemistry

- BioEngineering

- Combinatorial Mathematics

- Nuclear Engineering Seminar: *in progress.*