Xiang Ni

CONTACT INFORMATION

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RESEARCH INTERESTS

Parallel Computing: Performance Optimization, Fault Tolerance, Parallel Runtime Systems, Algorithms

EDUCATION

University of Illinois at Urbana Champaign, Urbana, Illinois USA

Ph.D. Candidate, Computer Science — Aug 2010 - Present
Advisor: Prof. Laxmikant V. Kalé
GPA: 3.77 (includes courses for M.S.)

University of Illinois at Urbana Champaign, Urbana, Illinois USA

M.S., Computer Science — Aug 2010 - May 2012

Beihang University, Beijing, China

B.E., Computer Science — Sep 2006 - Jun 2010
GPA: 3.7 (overall), 3.9 (major)

WORK EXPERIENCE

Summer Intern, Lawrence Livermore National Lab — May 2014 - Aug 2014
Mentor: Kathryn Mohror
Fault Tolerance: Lossy Compression for Checkpointing in HPC

Summer Intern, Walt Disney Animation Studio — May 2013 - Aug 2013
Mentor: Rasmus Tamstorf
Parallel Applications: Distributed Cloth Simulation

Summer Intern, Lawrence Livermore National Lab — May 2012 - Aug 2012
Mentor: Greg Bronevetsky
Performance Optimization: Autonomic Optimization of Sparse Computations

RESEARCH

PARALLEL APPLICATIONS DEVELOPMENT AND OPTIMIZATION

Scalable Cloth Simulation

- In collaboration with Disney Research, developed a distributed scalable first of its kind cloth simulation application using Charm++ parallel runtime system.
- Proposed and implemented scalable load balancing strategies and asynchronous communication optimizations suitable for irregular applications such as cloth simulation.
- Achieved 10x speedup for cloth simulation in comparison to the state-of-the-art shared memory implementation with good scaling to 384 cores.

Out-of-core Execution of HPC Applications

- Augmented the Charm++ and Adaptive MPI runtime system with support for executing applications with memory requirements larger than DRAM.

- Deployed prefetching and request aggregation to improve performance in the two-level memory system of DRAM and non-volatile memory.

PARALLEL RUNTIME TECHNIQUES FOR FAULT TOLERANCE

Handling Silent Data Corruptions in Parallel Applications

- Designed and implemented a replica based in-memory checkpointing framework to protect applications from both hard and soft errors.
- Demonstrated the scalability of the framework for Adaptive MPI and Charm++ applications using topology-aware mapping on large supercomputers.
- Currently working on compiler-based automated selective replication methods to improve the efficiency of the framework.

Reducing Checkpoint Overheads at Scale

- Developed an asynchronous checkpointing protocol to reduce the checkpointing overheads by 80% in production Charm++ and Adaptive MPI applications.
- Augmented the runtime system to overlap the checkpointing with application execution with adaptive prioritization for the application to minimize checkpointing interference.
- Ongoing work to automatically decide the optimal checkpoint strategy for various applications based on network simulation.

Alleviating Memory Pressure for Checkpointing

- Devised a method to efficiently use SSD for storing checkpoints instead of DRAM.
- Developed a framework to selectively use lossy compression techniques for storing checkpoints, and analyzed the trade-offs between the loss of precision and the compression ratio.

PUBLICATIONS

Xiang Ni, Laxmikant V. Kale, **Mitigation of Failures in High Performance Computing via Runtime Techniques**. SC 2015 Doctoral Showcase.

Xiang Ni, Laxmikant V. Kale, Rasmus Tamstorf, **Scalable Asynchronous Contact Mechanics using Charm++**. IPDPS 2015.

Esteban Meneses, **Xiang Ni**, Terry Jones, Don Maxwell, **Analyzing the Interplay of Failures and Workload on Titan Supercomputer**. CUG 2015.

Xiang Ni, Laxmikant V. Kale, Rasmus Tamstorf, **Scalable Asynchronous Contact Mechanics with Charm++**. SC 2014, ACM SRC poster.

Xiang Ni, Tanzima Islam, Kathryn Mohror, Adam Moody, Laxmikant V. Kale, **Lossy Compression for Checkpointing: Fallible or Feasible?** SC 2014, poster.

Esteban Meneses, **Xiang Ni**, Gengbin Zheng, Celso Mendes, Laxmikant V. Kale, **Using Migratable Objects to Enhance Fault Tolerance Schemes in Supercomputers**. TPDS 2014, Journal.

Bilge Acun, Abhishek Gupta, Nikhil Jain, Akhil Langer, Harshitha Menon, Eric Mikida, **Xiang Ni**, Michael Robson, Yanhua Sun, Ehsan Totoni, Lukasz Wesolowski, Laxmikant Kale. **Parallel Programming with Migratable Objects: Charm++ in Practice**. SC 2014.

Nikhil Jain, Abhinav Bhatele, **Xiang Ni**, Nicholas J. Wright, Laxmikant V. Kale. **Maximizing Network Throughput on the Dragonfly Interconnect**. SC 2014.

Xiang Ni, Esteban Meneses, Nikhil Jain, Laxmikant V. Kale. **ACR Automatic Checkpoint/Restart for Soft and Hard Error Protection**. SC 2013.

Xiang Ni, Esteban Meneses, Laxmikant V. Kale. **Hiding Checkpoint Overhead in HPC Applications with a Semi-Blocking Algorithm**. Cluster 2012.

Xiang Ni. **A Semi-Blocking Checkpoint Protocol to Minimize Checkpoint Overhead**. Master Thesis 2012.

Esteban Meneses, **Xiang Ni**, Laxmikant V. Kale. **A Message Logging Protocol for Multicore Systems**. FTXS 2012.

Gengbin Zheng, **Xiang Ni**, Laxmikant V. Kale. **A Scalable Double In-memory Checkpoint and Restart Scheme towards Exascale**. FTXS 2012.

Honors and Awards

Selected to attend MIT EECS Rising Stars, 2015
Best Poster, LLNL Annual Student Poster Session, 2014.
Runners-up, Coding Illini Team, Intel Parallel Universe Computing Challenge, SC 2013.
National Scholarship (3/175), Beihang University, 2009.

Computer Skills

- Programming Language: C++, C, MPI, OpenMP, Charm++, python, R
- Tools: LaTex, gnuplot, Make, VTune